I. C. 6892 August 1936

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

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INFORMATION CIRCULAR

REVIEW OF LITERATURE ON EFFECTS OF BREATHING DUSTS WITH SPECIAL REFERENCE TO SILICOSIS

PART III-B

CHAPTER 5. ECONOMIC AND LEGAL ASPECTS OF DUST DISEASE IN INDUSTRY
(SECTIONS 3 AND 4)

BY

D. HARRINGTON AND SARA J. DAVENPORT

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DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

REVIEW OF LITERATURE ON EFFECTS OF BREATHING DUSTS WITH SPECIAL REFERENCE TO SILICOSIS[1]

PART III-B

By D. Harrington[2] and Sara J. Davenport[3]

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Part III-B, presented in this circular, completes the series reviewing the literature on effects of breathing dusts with special reference to silicosis; it includes data on the status and cost of compensation for silicosis in the United States and several foreign countries and a summary and general conclusions covering the whole series. Parts I, II, and III-A of the series have been issued as Information Circulars 6835, 6840, 6848, and 6857; Part I defines and classifies dusts, indicates sources of exposure, and describes the physiological effects of breathing dusts; Part II-A discusses the principal dust factors producing pulmonary pathology and methods of determination of dust in air; Part II-B presents data on the engineering and medical control in the prevention of dust diseases and general recommendations for their control in industry; and Part III-A deals with the economic and legal aspects of dust diseases in industry.

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CHAPTER 5. ECONOMIC AND LEGAL ASPECTS OF DUST DISEASE IN INDUSTRY

Section 3. - Status of Compensation for Silicosis

United States

Although workmen's compensation laws were in operation in 44 States, only 12 States compensated for occupational diseases before 1934. Three of these - Minnesota, New Jersey, and Ohio (also Puerto Rico) - had scheduled "such occupational diseases as shall be considered compensable" but had not listed silicosis. In the remaining six States, two territories, and the District of Columbia the compensation laws brought occupational diseases under a general coverage or through interpretation of the words" personal injuries arising out of the employment" unqualified by any requirement that such injury "shall be by accident." Under this type of law, according to Keiser (442), silicosis might be considered a compensable occupational disease in California, Connecticut, District of Columbia, Hawaii, Massachusetts, Missouri (occupational diseases covered optionally under the workmen's compensation act by mutual consent of employer and employee), North Dakota, Philippine Islands, and Wisconsin.

In 1932 a decision of the Illinois Supreme Court placed silicosis legally under the State workmen's compensation act (443); by an act of the 1934 Kentucky Legislature "employers and employees engaged in certain industries may voluntarily subject themselves with respect to the disease of silicosis caused by the inhalation of silica dust" (444). Silicosis, especially silicosis accompanied by tuberculosis, has for some years been awarded compensation in California, Connecticut, Massachusetts, and Wisconsin, but in the last three States upon terms and conditions not yet definitely established (442). West Virginia amended the Workmen's compensation act, effective March 1935, to include silicosis (445). A new occupational-disease law for North Carolina, including asbestosis and silicosis among the compensable diseases, was ratified on March 26, 1935 (446), although before its enactment silicosis was brought within the coverage of the compensation law by "broad interpretation" according to the following statement by Sayer (447) in an address on "The Realities of Workmen's Compensation:

> Thus, while the North Carolina law specifically and in terms excludes all occupational diseases, none the less one of the most controversial of all occupational diseases is in one wide gesture brought within the coverage of the law in that State by "broad interpretation."
>
> Should this broad interpretation of North Carolina be accepted in other States, where the definitions are substantially the same, we would find that the whole category of dusty respiratory diseases, including silicosis, and the rest, besides asbestosis, would be brought within the coverage of the act, although in most of the States this class of diseases has been separately considered and rejected by the State legislatures. One immediate effect would be to impose upon employers and insurance carriers a liability that never was contemplated or intended, a liability so burdensome, in fact, that many companies could not stand the financial strain.

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On September 1, 1935, silicosis became a compensable disease in New York through an amendment to the workmen's compensation act to include "any and all occupational diseases" (448). An act passed by the New York Legislature to amend the workmen's compensation law included specific provisions for dealing with silica diseases but was vetoed by the Governor. In a memorandum accompanying his disapproval the Governor said (449):

> This bill amends the workmen's compensation law to provide special compensation for injuries resulting from the inhalation of harmful dust, particularly prevalent in certain industries. The provisions of this bill were sponsored principally by representatives of industry and insurance companies. Upon further consideration of the bill they now believe it contains inadvisable features. Many industrialists and insurance companies have urged that the bill be vetoed. Even though this bill did not become law, working men who suffer injuries from silicosis or other harmful dust diseases will, nevertheless, be protected and compensated under the workmen's compensation act because of the bill recommended by means of the legislature this year, which will bring all occupational diseases within the scope of the workmen's compensation law.

Under the bill vetoed by the Governor of New York all workers who were employed for a specified time in industries having a silica-dust hazard and who had any stage of silicosis, as disclosed by X-ray examination, would have been eligible for benefit the minute the Governor signed the bill. It would not have been necessary to show that disability was due to silicosis. Some estimated that this provision would have exposed industry to charges as high as $10,000,000 for additional compensation-insurance premiums to cover payment for disabilities which employees undoubtedly had already contracted through work in dusty occupations (449).

A digest of the laws of each State with reference to compensation for silicosis, issued in 1934 (450), includes decisions based on statutes which expressly allow recovery for occupational diseases and cites common-law cases which are not covered by any statute. Cases are cited of compensation allowed for dust diseases under the workmen's compensation act in six States with no occupational-disease act and in one State with an occupational-disease act which does not include silicosis in the schedule.

To indicate the trend in silicosis-compensation legislation in the United States the provisions relating to silicosis of the West Virginia and North Carolina acts are quoted. The West Virginia act states (445):

> Effective in March 1935 providing for compensation for disability, disablement, or death resulting from silicosis and defining silicosis.
>
> That chapter 23 of the code of West Virginia, 1931, be amended by the addition of a new article thereto, designated as article 6, consisting of sections 1 to 18, inclusive, to read as follows:

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Article VI: Section 1. - The provisions of this article shall be administered by the State compensation commissioner, and the provisions of article 1 of this chapter are applicable hereto. All charges and expenses peculiar to the administration of this article shall in the proportionate amount be chargeable to and paid out of the workmen's compensation silicosis fund.

Section 2. - (a) In order that compensation for the disease of silicosis as herein defined might be paid to all persons employed within this State in interstate or intrastate work, as defined by section 10, article 2, of this chapter, and in the service of those employers legally doing or authorized to do business in this State and who elect to qualify under and subject themselves to the provisions of this article, the commissioner shall make the necessary separate classifications of the various industries for those employers who so elect, and the commissioner shall make such classifications and fix the rate of premiums in the manner provided by section 4 of article 2 of this chapter. Those employers who do not elect to come within the provisions of this article shall not be subject to the provisions of article 2 of this chapter except as otherwise specifically provided in this article. The assessments and premiums paid by such employers so electing shall be kept by the commissioner in a separate fund to be known and designated as "workmen's compensation silicosis fund."

(b) For the purpose of creating the workmen's compensation silicosis fund each employer electing to become subject thereto under the provisions of this article shall make his election and pay the premiums in the manner provided by section 5 of article 2 of this chapter.

(c) Every employer electing to come under the provisions of this article shall give the information, and make the necessary reports, to the commissioner as provided by sections 2 and 3 of article 2 of this chapter.

(d) Except as otherwise herein specifically provided, all the provisions of this chapter relating to premiums and assessments paid into, and disbursements for benefits, compensation, medical and hospital treatment, funeral expenses, and other charges from, the fund designated as "workmen's compensation fund", and the limitations of the amounts to be thereby expended, shall likewise apply to the fund designated as "workmen's compensation silicosis fund"; and the term "workmen's compensation fund" as used in this chapter, whenever applicable, shall be construed to mean and include the term "workmen's compensation silicosis fund."

Section 3. - Each employer electing to pay the premiums provided by this article into the workmen's compensation silicosis fund, or electing to make direct payments of compensation as provided by section 9 of article 2 of this chapter, shall post, and keep posted, in conspicuous places about his place or places of business, typewritten or printed notices in the form prescribed by the commissioner, stating

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the fact that such employer has made such election, and the same when so posted shall constitute sufficient notice to all his employees, and to the parents of any minor employees, of the fact that the employer has made such election; and any employer who makes such election shall not thereafter be liable to respond in damages at common law or by statute for the disease or death of any employee because of silicosis during the period in which such employer shall not be in default in the payment of such premiums and shall have complied fully with all other provisions of this article.

Section 4. - (a) The commissioner shall establish a fund, to be known as "workmen's compensation silicosis fund", from the premiums and other funds paid thereto by employers who have elected to pay and have paid the premiums applicable to such employers under the provisions of this article relating to silicosis, for the benefit of employees of employers who have paid the premiums applicable to such employers, and have otherwise complied fully with the provisions of section 5, article 2, of this chapter, and for the benefit of the dependents of such employees, and for the payment of the administration expenses of this article, and shall adopt rules and regulations in respect to the collection, maintenance, and disbursement of such funds not in conflict with the provisions of this chapter.

(b) Ten percent of all that shall hereafter be paid into the workmen's compensation silicosis fund shall be set aside for the creation of a sufficient surplus fund, within the discretion of the commissioner, not exceeding $100,000, after which the sum of 5 percent of all the money paid into such fund shall be credited to such surplus fund until such time as in the judgment of the commissioner such surplus fund shall be sufficiently large to cover the catastrophe hazard and all losses not otherwise specifically provided for in this article.

Employers electing as provided by this chapter to individually and directly compensate their employees having silicosis, or their dependents, shall do so in the manner prescribed by the compensation commissioner and shall make all reports and execute all blanks, forms, and papers as directed by said commissioner and as herein provided in this chapter.

(d) The custody, investment, and disbursement of the workmen's compensation silicosis fund shall be in the manner and form prescribed by section 2, article 3, of this chapter, and any and all amendments thereto.

Section 5. - The commissioner shall disburse the workmen's compensation silicosis fund to the employees of such employers as are not delinquent in the payment of premiums for the last month in which said employees have been exposed to silicon dioxide dust in

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harmful quantities and who have otherwise complied fully with the provisions of this article, and which employees shall have contracted silicosis in this State in the course of and resulting from their employment, or to the dependents, if any, of such employees, in case death has ensued, according to the provisions hereinafter made.

Where an employee suffers from the disease of silicosis as hereinafter defined, or dies as the result of such disease, and the disease is due to the nature of an occupation or process in which he was employed at any time within 1 year previous to such disease, and claim therefor has been made within 1 year after the last exposure of said employee to silicon dioxide dust in harmful quantities, the employee, or in case of death his dependents, shall be entitled to compensation for silicosis as provided herein: Provided, however, That compensation shall not be payable for the disease of silicosis, or death resulting therefrom, unless the employee has been exposed to the inhalation of silicon dioxide dust in harmful quantities over a period of not less than 2 years in the same employment in this State.

For the purposes of this article silicosis is defined as an insidious fibrotic disease of the lung or lungs due to prolonged inhalation and accumulation sustained in the course of and resulting from his employment, of minute particles of dust containing silicon dioxide (SiO_2) over such a period of time and in such amounts as result in the substitution of fibrous tissue for normal lung tissues; and the term "silicosis" as used herein shall also include silicosis accompanied by tuberculosis of the lungs evidenced by the presence of tubercle bacillus in the sputum.

Section 6. - Notwithstanding anything hereinbefore or hereinafter contained, no employee or dependent of any employee shall be entitled to receive any sum from the workmen's compensation silicosis fund, or to direct compensation from any employer making the election and receiving the permission mentioned in section 9, article 2, of this chapter, or otherwise under the provisions of this chapter, on account of contracting the disease of silicosis caused by willful misconduct, willful self-exposure as defined herein, disobedience to such rules and regulations as may be adopted by the commissioner, and which rules and regulations have been and are kept posted in conspicuous places in and about the premises, or the failure of such employee to use or make use of any protective or safety appliance or appliances prescribed by the commissioner and furnished by the employer for the use of or applicable to such employee, nor shall any employee or dependent thereof maintain any action for damages on account of disability arising from the disease of silicosis contracted through willful self-exposure as defined herein. For the purposes of this article and to prevent employees from contracting silicosis the commissioner may require all employers to adopt rules which have been approved by him for the protection and safety of his employees and keep the same posted in conspicuous places in and about the premises; and the commissioner shall require employers to install, use, or

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adopt such protective or safety appliances as in the commissioner's opinion are necessary for the protection of the employees. If silicosis or death therefrom result to any employee from the deliberate intention of his employer to produce silicosis or death therefrom the employee, the widow, widower, child, or dependent of the employee shall have the privilege to take under this article, and shall also have cause of action against the employer as if this chapter had not been enacted for any excess of damages over the amount received or receivable under this chapter. As used in this section, the term, "deliberate intention," shall mean conscious and willful determination.

As used in this section, the term "willful self-exposure", causing the contraction of the disease of silicosis, shall include: (1) Failure or omission on the part of an employee to observe such rules and regulations as may be adopted by the employer and approved by the commissioner and which rules and regulations have been and are kept posted in a conspicuous place in and about the premises; (2) failure or omission on the part of an employee truthfully to state to the best of his knowledge in answer to inquiry made by the employer, the place, duration, and nature of previous employment; (3) failure or omission on the part of an employee truthfully to answer to the best of his knowledge in answer to an inquiry made by the employer concerning full information about the previous status of his health, habits, and medical attention that he or his blood relative may have heretofore received.

Section 7. - An employee shall, for the purposes hereof, be deemed to have silicosis: (1) In the first stage, when it is found by the commissioner that the earliest detectable specific signs of silicosis are present, whether or not capacity for work is or has been impaired by such silicosis; (2) in the second stage, when it is found by the commissioner that definite and specific physical signs of silicosis are present and that capacity for work is or has been impaired by that disease; (3) in the third stage, when it is found by the commissioner that the employee has silicosis accompanied by tuberculosis of the lungs evidenced by the presence of tubercle bacillus in the sputum.

Where compensation for silicosis is due an employee under the provisions hereof, such compensation shall be provided in the following schedule: (a) If the employee is suffering from silicosis in the first stage, the employee shall receive the sum of $500 as compensation in full for said disease that he has sustained as a result of and in the course of his employment, said sum to be payable as a lump sum or in periodic installments in the discretion of the commissioner, and shall be a final payment and operate as a full release by the employee for compensation and for any claim against the employer that the employee may thereafter have for silicosis, and irrespective of whether the employee thereafter continues in the same employment, he shall not have the right to receive any or further compensation or

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make any claim because of silicosis either to the compensation commissioner or against his employer, anything to the contrary in this chapter notwithstanding; (b) if the employee is suffering from silicosis in the second stage, the employee shall receive the sum of $1,000 as compensation in full for said disease that he has sustained as a result of and in the course of his employment, said sum to be payable as a lump sum or in periodic installments in the discretion of the commissioner, and shall be a final payment and operate as a full release by the employee for compensation and for any claim against the employer that the employee may hereafter have for silicosis, and irrespective of whether the employee thereafter continues in the same employment, he shall not have the right to receive any or further compensation or make any claim because of silicosis either to the commissioner or against his employer, anything to the contrary in this chapter notwithstanding; (c) if the employee is suffering from silicosis in the third stage, the compensation shall be paid therefor in the same manner and at the same rate as is provided for permanent disability under the provisions of subdivisions (c), (f), and (h) of section 6, article 4, of this chapter; (d) if the employee dies from silicosis within 1 year from the date of the last exposure of the employee to silicon dioxide dust in harmful quantities, the benefits shall be in the amounts and to the persons provided for in section 1, article 4, of this chapter; as to such benefits sections 11 to 14, inclusive, of article 4 of this chapter shall apply.

Section 8. - The commissioner shall have power, after due notice to the employer, and whenever in his opinion it shall be necessary, to order a claimant to appear for examination before the medical board hereinafter provided. Claimant shall be entitled to reasonable traveling and other expenses necessarily incurred by him in obeying such order, which shall be paid out of the workmen's compensation silicosis fund within the amount allowed for medical, surgical, and hospital treatment.

Section 9. - (a) To entitle any employee to compensation for silicosis under the provisions hereof, the application therefor must be made on a form or forms prescribed by the commissioner and filed in the office of the commissioner within 1 year from and after the date of the last injurious exposure to silicon dioxide dust, or in case of death the application shall be filed as aforesaid by the dependent of such employee within 1 year from and after the date of the last injurious exposure to silicon dioxide dust.

(b) Nonresident aliens may be officially represented by the consular officers of the country of which such aliens may be citizens or subjects: Provided, That nothing herein contained shall be construed as giving such consular officer the right to make application for compensation in behalf of the non-resident aliens.

Section 10. - Unless the employer during the continuance of employment shall have actual knowledge that the employee has contracted silicosis, or unless the employee or some one on his behalf

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or his dependents shall give written notice of a claim that such employee has contracted silicosis, within a period of 1 year after the date when said employee shall have ceased to be subject to injurious exposure to silicon dioxide dust in employment with said employer, no compensation shall be allowed and paid on account of death or disability of such employee by reason of silicosis.

Section 11. - On the hearing of a claim for compensation for silicosis, the commissioner shall hear, determine, and file findings covering, but not limited to, the following nonmedical questions:

(a) Whether the employee was in fact, within 1 year prior to the filing of his claim, in the employ of the employer, and, if so, the duration of such employment and whether or not such employment was subject to the provisions hereof.

(b) The occupation or occupations, process or processes in which the employee was engaged during such employment, and the approximate periods of work in each such occupation or process.

(c) The employments, previous and subsequent to the employment out of which the claim arose, the duration thereof, and the exposure therein to the hazard of silicon dioxide dust.

(d) Whether such employee contracted said disease through willful self-exposure.

(e) The average weekly wages of the employee at the time of his last injurious exposure to silicon dioxide dust in the employment of the employer.

(f) The date of the last injurious exposure to silicon dioxide dust in the employment with the employer, and if the employee is no longer in the service of the employer, the date upon which said employee ceased so to work, and, if the employee has died, the date and place of such death and the place of interment of the body.

Section 12. - There shall be a medical board, known as the "silicosis medical board", which shall consist of three licensed physicians, who shall be appointed by the commissioner. No person shall be appointed as a member of said board, or as a consultant thereto, who has not by special study or experience, or both, acquired special knowledge of pulmonary diseases. All members of the silicosis medical board shall be physicians of good professional standing, admitted to practice medicine and surgery in this State, and two of said physicians shall be roentgenologists. One of the board shall be designated annually as chairman by the commissioner. The term of office of each member of such board shall be 6 years, except that the terms of the members first appointed shall be 2, 4, and 6 years respectively. The function of such board shall be to determine all medical questions in cases of compensation for

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silicosis under the direction and supervision of the commissioner. The commissioner, from time to time, shall fix the per-diem salary, computed on the basis of actual time devoted to the discharge of their duties, to be paid each member of such board, and they shall also be entitled to reasonable and necessary traveling and other expenses incurred while actually engaged in the performance of their duties.

Section 13. - The silicosis medical board, upon reference to it by the commissioner of a case of silicosis, shall notify the employee, or in case he is dead, the claimant, and the employer, to appear before such board at a time and place stated in the notice. If the employee be living, he shall appear before the board at the time and place specified and submit to such examinations, including clinical and X-ray examinations, as the board may require. If a physician licensed to practice medicine in the State shall make affidavit that the employee is physically unable to appear at the time and place designated by the board, such board shall, on notice to the proper parties, change the place and time of examination to such other place and time as may reasonably facilitate the hearing or examination of the employee. The employee, or in case he is dead, the claimant, and the employer shall also produce as evidence to the board all reports of medical and X-ray examinations which may be in their respective possession or control, showing the past or present condition of the employee. If the employee be dead, the notice of the board shall further require that the claimant produce necessary consents and permits so that an autopsy may be performed, if the board shall so direct. When in the opinion of the board an autopsy is deemed necessary to accurately and scientifically ascertain and determine the cause of death, such autopsy examination shall be ordered by the board, which shall designate a duly licensed physician, a pathologist, or such other specialists as may be deemed necessary by the board, to make such examination and tests to determine the cause of death and certify his or their written findings, in triplicate, to said board, and which findings shall be public records. In the event that a claimant for compensation for such death refuses to consent and permit such autopsy to be made, all rights for compensation shall thereupon be forfeited.

The employee, or if he be dead, the claimant, and the employer, shall be entitled to be present at all examinations conducted by the board and to be represented by attorneys and physicians.

Section 14. - The silicosis medical board, as soon as practicable after it has completed its investigation, shall make its written report, in triplicate, to the commissioner, of its findings and conclusions on every medical question in controversy, and the commissioner shall send one copy thereof to the employee or claimant and one copy to the employer, and the said board shall also return to and file with the commissioner all the evidence, as well as all statements under oath, if any, of the persons who appeared before it on behalf of the employee or claimant, or employer, and also all medical

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reports and X-ray examinations produced by or on behalf of the employee or claimant, or employer.

The findings and conclusions of the said board shall set forth, among other things, the following:

(a) Whether or not the claimant or the deceased employee has contracted silicosis, and, if so, the stage thereof,

(b) If the claimant or the deceased employee has contracted such disease, whether or not the exposure in the employment, with said employer, was sufficient to have caused silicosis or to have injuriously aggravated an existing silicosis,

(c) What, if any, physician appeared before the board on behalf of the claimant, and what, if any, X-rays were produced by or on behalf of the claimant, and what, if any, physician appeared before the board on behalf of the employer, and what, if any, X-rays were produced by or on behalf of the employer.

If either party object to the whole or any part of such findings and conclusions of the board, he shall file with the commissioner, within 10 days of the mailing of said copy to him, unless for good cause shown the commissioner extends said time, his objections, in writing, thereto, specifying the particular statements of the board's findings and conclusions to which he objects. After the time has expired for the filing of objections to the findings and conclusions of the board, the commissioner shall proceed to act as provided in this chapter. If after the time has expired for the filing of objections to the findings and conclusions of the board no objections have been filed, the report of a majority of the board of its findings and conclusions on any medical question shall be taken to be plenary and conclusive evidence of the findings and conclusions therein stated. If objection has been filed to the findings and conclusions of the board, notice thereof shall be given to the board, and the members thereof joining in such findings and conclusions shall appear at the time fixed by the commissioner for the hearing to submit to examination and cross examination in respect to such findings and conclusions. At such hearing evidence to controvert the findings and conclusions of the board shall be limited to examination and cross examination of the members of the board appearing, and in addition thereto only the testimony of such physician or physicians as may have appeared before the board on behalf of the claimant or the employer, or each, and participated in all of the examinations conducted by such board: Provided, That if such physician shall have died or is physically unable to attend, after appearing before said board, the party whom he represented may select any other duly licensed physician of West Virginia and may introduce his testimony in addition to that of one who has so died or is so physically unable to attend.

Section 15.- The provisions hereof shall not apply to cases of silicosis in which the last injurious exposure to silicon dioxide dust in harmful quantities occurred before the provisions hereof shall have taken effect: Provided, That any employer hereunder may elect to provide and

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pay compensation hereunder for silicosis in which the last injurious exposure to the hazards of such disease occurred before the provisions hereof shall have taken effect, by filing notice of such election with the commissioner and posting copies of said notice in conspicuous places on his premises, and every employee who is employed at the time of posting such notice shall be deemed to have accepted all the provisions hereof and shall be bound thereby unless within 30 days after the filing and posting of such notice such employee shall file a notice to the contrary with the commissioner, whose duty it shall be to immediately notify the employer: Provided further, That any employer and any former employee thereof, prior to the date the provisions hereof take effect, when such former employee claims to have contracted silicosis, may by an agreement in writing elect to accept the provisions hereof, whereupon such former employee shall file his application with the commissioner, and the commissioner is hereby authorized to act in such cases, in which event all charges for administration and other expenses shall be charged to the particular employer, and if the commissioner finds that compensation should be paid, he shall determine the total amount and all administration charges thereof and assess same against the particular employer, who shall at once make payment of the full amount thereof into the workmen's compensation silicosis fund, and such amount so awarded shall be disbursed by the commissioner as in any other case arising under the provisions hereof.

Section 16.- Compensation shall be paid only to or for the use of such employees, or their dependents, as herein provided, and shall be exempt from all claims of creditors and from any attachment, execution, or assignment. Payments shall be made in such periodical installments as may seem best to the commissioner in each case.

Section 17.- Any person who shall knowingly and with fraudulent intent secure or attempt to secure larger compensation, or compensation for a longer term than he is entitled to, from the workmen's compensation silicosis fund, or knowingly and with like intent secure or attempt to secure compensation from such fund when he is not entitled thereto, or shall knowingly and with like intent aid or abet anyone in the commission of the offenses herein set forth, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not exceeding $500 or imprisoned not exceeding 12 months, or both, in the discretion of the court, and if the person so convicted is receiving compensation from such fund, he shall from and after such conviction cease to receive such compensation.

Section 18.- The provisions of section 1, article 5, of this chapter, providing for the finality of the commissioner's rulings and the review by the supreme court of appeals, are applicable to the provisions of this article.

All acts and parts of acts in conflict with this act, or any part thereof, are hereby repealed. The various provisions of this act shall be construed as separable and several, and should any of the provisions, sentences, clauses, or parts thereof be construed or held unconstitutional, or for any other reason invalid, the remaining provisions of this act shall not be thereby affected.

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North Carolina's new occupational-disease law (446), ratified March 26, 1935, was drafted after conferences between employees and employers. Between 40 and 50 employer representatives, as well as representatives from the home offices of several insurance companies and the State insurance commissioner, were present at the initial meetings. The president of the State federation of labor participated in the various conferences. According to Industrial Medicine (446) a few outstanding features of the bill are: It probably is one of the first laws in the country to provide for physical examinations of prospective employees as well as periodical examinations of those now engaged in the industries creating the two most harmful dusts, asbestos and silica; it stipulates removal of employees in the very early stages and, as part of the removal program, provides for vocational education - the first and only bill to do so; it also provides for a medical set-up. The following paragraphs of the law refer particularly to asbestosis and silicosis:

> Section 50½.- (a) The disablement or death of an employee resulting from an occupational disease described in paragraph (b) of this section shall be treated as the happening of an injury by accident within the meaning of the North Carolina Workmen's Compensation Act and the procedure and practice and compensation and other benefits provided by said act shall apply in all such cases except as hereinafter otherwise provided. The word "accident" as used in the workmen's compensation act shall not be construed to mean a series of events in employment, of a similar or like nature, occurring regularly, continuously, or at frequent intervals in the course of such employment, over extended periods of time, whether such events may or may not be attributable to fault of the employer, and disease attributable to such causes shall be compensable only if culminating in an occupational disease mentioned in and compensable under this act. Provided, however, no compensation shall be payable for asbestosis and/or silicosis as hereinafter defined if the employee, at the time of entering into the employment of the employer by whom compensation would otherwise be payable, falsely represented himself in writing as not having previously been disabled or laid off because of asbestosis or silicosis. ***
>
> (c) The term "disablement" as used in this section as applied to cases of asbestosis and silicosis means the event of becoming actually incapacitated, because of such occupational disease, from performing normal labor in the last occupation in which remuneratively employed; but in all other cases of occupational disease shall be equivalent to "disability" as defined in Section 2, paragraph (1) of the North Carolina Workmen's Compensation Act.
>
> (d) The term "disability" means the state of being incapacitated as the term is used in defining "disablement" in paragraph (c) hereof.
>
> (e) The provisions of this act shall apply only to cases of occupational disease in which the last exposure in an occupation subject to the hazards of such disease occurred on or after the date on which this section shall have taken effect.

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(f) In any case where compensation is payable for an occupational disease the employer in whose employment the employee was last injuriously exposed to the hazards of such disease, and the insurance carrier, if any, which was on the risk when the employee was so last exposed under such employer, shall be liable.

(g) An employer shall not be liable for any compensation for asbestosis, silicosis, or lead poisoning unless disablement or death results within 3 years after the last exposure to such disease, or, in case of death, unless death follows continuous disability from such disease, commencing within the period of 3 years limited herein, and for which compensation has been paid or awarded or timely claim made as hereinafter provided and results within 7 years after such last exposure. Claims for all other occupational diseases shall be barred unless claims shall be filed with the industrial commission within 1 year from the disablement or death caused by such occupational disease.

(h) In the event of disability from an occupational disease, the employer shall provide reasonable medical and/or other treatment for such time as in the judgment of the industrial commission will tend to lessen the period of disability or provide needed relief; provided, however, medical and/or other treatment for asbestosis and/or silicosis shall not exceed a period of 3 years nor cost in excess of $334 in any 1 year; and, provided further, all such treatment shall be first authorized by the industrial commission after consulting with the advisory medical committee.

(i) The compulsory examination of employees and prospective employees as herein provided applies only to persons engaged or about to engage in an occupation which has been found by the industrial commission to expose them to the hazards of asbestosis and/or silicosis. The industrial commission shall designate by order each industry found subject to any such hazard and shall notify the employers therein before such examinations are required. On and after the date on which this act becomes operative it shall be the duty of every employer in the conduct of whose business his employees or any of them are subjected to the hazards of asbestosis and/or silicosis to provide prior to employment necessary examinations of all new employees for the purpose of ascertaining if any of them are in any degree affected by asbestosis and/or silicosis or peculiarly susceptible thereto; and every such employer shall from time to time, as ordered by the industrial commission, provide similar examinations for all of his employees whose employment exposes them to the hazards of asbestosis and/or silicosis. At least one member of the advisory medical committee or other physician designated by the industrial commission shall make such examinations or be present when any such examination is made. The refusal of an employee to submit to any such examination shall bar such employee from compensation or other benefits provided by this act in the event of disablement and/or death resulting from an exposure to the hazards of asbestosis and/or silicosis subsequent to such refusal.

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It shall be the duty of the industrial commission to make and/or order such inspections of employments and to keep a record of all employments subjecting employees to the hazards of asbestosis and/or silicosis and to notify the employer in any case where such hazard shall have been found to exist. The unreasonable failure of an employer to provide for any examination or his unreasonable refusal to permit any inspection herein authorized shall constitute a misdemeanor and shall be punishable as such.

(j) Where an employee, though not actually disabled, is found by the industrial commission to be affected by asbestosis and/or silicosis, and it is also found by the industrial commission that such employee would be benefited by being taken out of his employment and that such disease with such employee has progressed to such a degree as to make it hazardous for him to continue in his employment and is in consequence removed therefrom by order of the industrial commission, he shall be paid compensation as for temporary total or partial disability, as the case may be, until he can obtain employment in some other occupation in which there are no hazards of such occupational disease; provided, however, compensation in no such case shall be paid for a longer period than 20 weeks to an employee without dependents, nor for a longer period than 40 weeks to an employee with dependents, and in either case said period shall begin from the date of removal from the employment, unless actual disablement from such disease results later and within the time limited in paragraph (g) of this section. When in any such case the forced change of occupation shall in the opinion of the industrial commission require that the employee be given special training in order to properly readjust himself there shall be paid for such training and incidental traveling and living expenses an additional sum which shall not exceed $300 in the case of an employee without dependents and which shall not exceed $500 in the case of an employee with dependents, such payment to be made for the benefit of the employee to such person or persons as the industrial commission may direct; provided, however, no such payment shall be made unless the employee accepts the spocial training herein provided, nor shall payment be made for a longer period of time than the employee shall accept such special training. If an employee has been so compensated, and whether or not specially trained for another occupation, and he thereafter engages in any occupation which exposes him to hazards of silicosis and/or asbestosis without first having obtained the written approval of the industrial commission, neithor he, his dependents, personal representative nor any other person shall be entitled to any compensation for disablement or death from silicosis and/or asbestosis: provided, however, that an employee so affected, as an alternative to forced change of occupation, may, subject to the approval of the industrial commission, waive in writing his right to compensation for any aggravation of his condition that may result from his continuing in his hazardous occupation; but in the event of total disablement and/or death as a result of asbestosis and/or silicosis with which the employee was so affected compensation shall nevertheless be payable, but in no case, whether for disability or death or both, for a longer period than 100 weeks. Such written waiver must be filed with the industrial commission, and the

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commission shall keep a record of each waiver, which record shall be open to the inspection of any interested person.

(k) The word "silicosis" shall mean the characteristic fibrotic condition of the lungs caused by the inhalation of dust of silica or silicates. "Asbestosis" shall mean a characteristic fibrotic condition of the lungs caused by the inhalation of asbestos dust.

(l) Compensation shall not be payable for disability or death due to silicosis and/or asbestosis unless the employee shall have been exposed to the inhalation of dust of silica or silicates or asbestos dust in employment for a period of not less than 2 years in this State, provided no part of such period of 2 years shall have been more than 10 years prior to the last exposure.

(m) Except as herein otherwise provided, in case of disablement or death from silicosis and/or asbestosis, compensation shall be payable in accordance with the provisions of the North Carolina Workmen's Compensation Act.

(n) In case of disablement or death due primarily from silicosis and/or asbestosis and complicated with tuberculosis of the lungs compensation shall be payable as hereinbefore provided, except that the rate of payments may be reduced one-sixth.

(o) Unless written notice of the first distinct manifestation of an occupational disease shall be given to the employer in whose employment the employee was last injuriously exposed to the hazards of such disease or to the industrial commission within 30 days after such manifestation, and, in case of death, unless also written notice of such death shall be given by the beneficiary hereunder to the employer or the industrial commission within 90 days after occurrence, and unless claim for disability and/or death shall be made within 1 year after the disablement or death, respectively, all rights to compensation for disability or death from an occupational disease shall be forever barred; provided, however, that notice and/or claim shall be deemed waived in case of disability or death where the employer or insurance carrier voluntarily makes compensation payments therefor, or, within the time above limited, has actual knowledge of the incurrence of the disease or of the death and its cause, or by his or its conduct misleads the injured employee or claimant reasonably to believe that notice and/or claim has or have been waived; and provided further that where compensation payments have been made and discontinued, and further compensation is claimed, whether for disability or death from asbestosis, silicosis or lead poisoning, the claim for such further compensation shall be made within 2 years after the last payment, but in all other cases of occupational-disease claim for further compensation shall be made within 1 year after the last payment.

(p) Upon the filing of a claim for death from an occupational disease where in the opinion of the industrial commission a post-mortem examination is necessary to accurately ascertain the cause of death,

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such examination shall be ordered by the Industrial Commission. A full report of such examination shall be certified to the industrial commission. The surviving spouse or next of kin and the employer or his insurance carrier, if their identity and whereabouts can be reasonably ascertained, shall be given reasonable notice of the time and place of such post-mortem examination, and, if present at such examination, shall be given an opportunity to witness the same. Any such person may be present at and witness such examination either in person or through duly authorized representative. If such examination is not consented to by the surviving husband or wife or next of kin, all right to compensation shall cease.

(q) If on the hearing of a claim for compensation for asbestosis and/or silicosis, any controverted medical question or questions shall arise, the industrial commission shall reserve its decision and award until it shall have received a report from the advisory medical committee; and the industrial commission may in its discretion refer to said committee controverted medical questions arising out of other occupational-disease claims.

(r) The advisory medical committee, upon reference to it of a case of occupational disease, shall notify the employee, or, in case he is dead, his dependents or personal representative, and his employer to appear before the advisory medical committee at a time and place stated in the notice. If the employee be living, he shall appear before the advisory medical committee at the time and place specified then or thereafter and he shall submit to such examinations including clinical and X-ray examinations as the advisory medical committee may require. The employee, or, if he be dead, the claimant and the employer shall be entitled to have present at all such examinations a physician admitted to practice medicine in this State who shall be given every reasonable facility for observing every such examination whose services shall be paid for by the claimant or by the employer who engaged his services. If a physician admitted to practice medicine in the State shall certify that the employee is physically unable to appear at the time and place designated by the advisory medical committee, such committee, may upon the advice of the industrial commission, and on notice to the employer, change the place and/or time of the examination so as to reasonably facilitate the examination of the employee, and in any such case the employer shall furnish transportation and provide for other reasonably necessary expenses incidental to necessary travel. The claimant and the employer shall produce to the Advisory medical committee all reports of medical and X-ray examinations which may be in their respective possession or control showing the past or present condition of the employee to assist the advisory medical committee in reaching its conclusions.

(s) The advisory medical committee shall, as soon as practicable after it has completed its consideration of a case, report to the industrial commission its opinion regarding all medical questions involved in the case. The advisory medical committee shall include in its

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report a statement of what, if any, physician or physicians were present at the examination on behalf of the claimant or employer and what, if any, medical reports and X-rays were produced by or on behalf of the claimant or employer.

(t) The advisory medical committee shall file its report in triplicate with the industrial commission, which shall send one copy thereof to the claimant and one copy to the employer by registered mail. Unless within 30 days from receipt of the copy of said report the claimant and/or employer shall request the industrial commission in writing to set the case for further hearing for the purpose of examining and/or cross-examining the members of the advisory medical committee respecting the report of said committee, said report shall become a part of the record of the case and shall be accepted by the industrial commission as expert medical testimony to be considered as such and in connection with all the evidence in the case in arriving at its decision.

(u) There shall be an advisory medical committee consisting of three members, who shall be licensed physicians in good professional standing and peculiarly qualified in the diagnosis and/or treatment of occupational diseases. They shall be appointed by the industrial commission with the approval of the Governor, and one of them shall be designated as chairman of the committee by the industrial commission. The members of the committee shall be appointed to serve terms as follows: One for a term of 2 years, one for a term of 4 years, and one for a term of 6 years. Upon the expiration of each term as above mentioned the industrial commission shall appoint a successor for a term of 6 years, except that the terms of the members first appointed shall expire June 30, 1936. The function of the committee shall be to conduct examinations and make reports as required by paragraphs (q), (r), (s), and (t) of this section and to assist in any post-mortem examinations provided for in paragraph (p) of this section when so directed by the industrial commission. Members of the committee shall devote to the duties of the office as much of their time as may be required in the conducting of examinations with reasonable promptness, and they shall attend hearings as scheduled by the industrial commission when their attendance is desired for the purpose of examining and cross-examining them respecting any report or reports made by them.

The members of the advisory medical committee shall be paid such salaries and/or fees and expenses, and in monthly installments or in such other manner as may be determined by the Governor and approved by the advisory budget commission.

The industrial commission shall establish a schedule of reasonable charges to defray the expenses incurred in making examinations pursuant to paragraphs (i) and (p) of this section, such charges to be collected in accordance with rules and regulations which shall be adopted by the industrial commission. Said charges shall be collected from employers who by order of the industrial commission are determined to be subject to the hazards of asbestosis and/or silicosis.

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In hearings arising out of claims for disability and/or death resulting from occupational diseases the industrial commission shall tax as a part of the costs in cases in which compensation is awarded a reasonable allowance for the services of members of the advisory medical committee attending such hearings and reasonable allowances for the services of members of the advisory medical committee for making investigations in connection with all claims for compensation on account of occupational diseases, including uncontested cases, as well as contested cases, and whether or not hearings shall have been conducted in connection therewith. All such charges, fees, and allowances to be collected by the Industrial Commission shall be paid into the General Fund of the State Treasury to constitute a fund out of which to pay the expenses of the advisory medical committee.

In the event the amount appropriated by the general assembly and the charges, fees, and allowances so assessed and collected and paid into the State treasury shall not be sufficient to pay the full cost incurred by the advisory medical committee in making examinations of employees, and conducting post-mortem examinations, and in making investigations of claims arising under this section, and in testifying before the industrial commission, the industrial commission shall assess against the employers found by the industrial commission to be subject to the hazards of asbestosis and/or silicosis an amount sufficient to pay such cost, said amount to be assessed against such employers pro rata on the basis of annual payroll. The industrial commission is authorized to assess and collect in advance in the beginning of any year from the employers subject to such hazard an amount estimated as necessary to pay such cost. Said amount when so assessed shall be paid by such employers within 10 days after the notice of assessment and when collected by the industrial commission shall be paid into the State treasury as a part of the fund out of which to pay the expenses of the advisory medical committee. In the event such amount so assessed shall be found to be in excess of the cost incurred by such advisory medical committee in the performance of its duties under this act, such excess shall be credited against the estimate of the cost to be incurred by said committee for the succeeding year. In case the amount so assessed shall be insufficient to pay such cost the industrial commission is authorized to make an additional assessment to be made at the end of the regular assessment period and to be collected from the employers subject to the hazards of asbestosis and/or silicosis.

(v) The industrial commission shall make inspections of employments for the purpose of ascertaining whether such employments, or any of them, are subject to the hazards of asbestosis and/or silicosis, and for the purpose of making studies and recommendations with a view to reducing and/or eliminating such hazards. The industrial commission, and/or any person selected by it, is authorized to enter upon the premises of employers where employments covered by this act are being carried on to make examinations and studies as aforesaid. Any employer, or any officer or agent of an employer, who unreasonably prevents or obstructs any such examination or study shall be guilty of a misdemeanor.

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(w) If any part or parts of this act be decided by the courts to be unconstitutional or invalid, the same shall not affect the validity of this act as a whole or any part thereof other than the part or parts so decided to be unconstitutional or invalid.

(x) This act shall be in force and effect from and after its ratification.

(y) All laws and clauses of laws in conflict herewith are hereby repealed.

It will be noted that under the West Virginia act employers may elect to come within its provisions, and the employer who makes such election is not liable to respond to damage suits at common law or by statute for the disease or death from silicosis of any employee during the period in which the employer is not in default of payment of the premiums assessed by the commission or who has complied fully with the provisions of the act. Under the North Carolina law the industrial commission determines what industries are subject to the hazards of asbestosis and silicosis, fixes the schedule of reasonable charges to defray the expenses of enforcing the law, and collects the charges from the employers.

After dust diseases have been included in compensation laws there are many obstructions in the path of legislation affording effective means for compensating workers with dust diseases. In 1932 the Illinois Supreme Court placed silicosis under the employee's compensation act; on April 17, 1935, the same court ruled that section 1 of the occupational-disease act was unconstitutional on the ground that it violated the "due process" clause of the State and Federal constitutions (443). The statutory provision held unconstitutional provided that —

> Every employer of labor in carrying on work which may produce any illness or disease peculiar to the work or process carried on, or which subject employees to the menace of illness or disease peculiar to such work to which ordinary employees are not exposed in other lines of employment, shall, to protect the employees, adopt and provide reasonable and approved devices or methods to prevent such industrial or occupational diseases as are incidental to such work.

The legislature, the court held (443), had failed to set up any standards by which judgment of the administrative department could be measured, and as a result the "department could decide arbitrarily what devices or methods are approved reasonably necessary, reasonable or adequate." By attempting to vest legislative powers in the department, the court held, the statute violated article 3 of the State constitution, and for the same reason sections 12 and 13 of the health, comfort, and safety act were held unconstitutional by the court. The court reversed the judgment of the Cook County circuit court, which had awarded $20,000 to the plaintiff who claimed he contracted pneumoconiosis through breathing fumes while employed by an Illinois steel company. It sustained the Cook County superior court which had dismissed a similar suit against a glass company.

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However, in a case in Missouri, decided on April 9, 1934 (451), in which the defendant challenged the constitutionality of the statutory provisions concerning protection against industrial diseases, the appellate court decided that such provisions were constitutional. In an action to recover for personal injuries, brought against a company by a former employee, the plaintiff alleged that the company had been negligent in failing to furnish a safe working place and in failing to observe the Missouri statutory provisions requiring employers to protect their employees against industrial or occupational diseases. The plaintiff's work was putting powdered lime, sulphate of iron, and soda ash into tanks of water to soften the water for use in the boilers of the company's plant. Dust resulted from this operation, and the court of appeals found substantial evidence that the dust inhaled was noxious, harmful, and injurious to health and potentially and actually productive of the condition suffered by the plaintiff. The judgment of the lower court in favor of the plaintiff was affirmed by the court of appeals:

> The claim of Jones that he had not been warned of the danger nor furnished with a respirator stands practically uncontradicted and is corroborated by the testimony of other witnesses. There was ample evidence from which the jury could have reached the verdict it did, and appellant's requested peremptory instruction to return a verdict for the defendant was properly overruled. It is conceded that neither warnings were given nor notices posted as required by law and by the exercise of due care for the safety of this employee.

Ohio (452) has a compensation law covering specific diseases and specific processes, but silicosis is not included among the 21 diseases listed. Each year a number of claims are filed in the State for conditions not included in the list of compensable occupational diseases; 40 such claims were filed during 1934, many of which were for noncompensable conditions resulting from tuberculosis, bronchitis, asthma, arthritis, and neuritis; a few cases of silicosis resulting from exposure to dust were included also.

On July 23, 1935, a suit was filed at Toledo, Ohio (453), challenging a part of article II, section 35, of the State constitution which denied the right of the plaintiff to sue his employer "for negligence causing the disease silicosis." The administratrix of the estate of the plaintiff asked permission to file a supplementary petition for $125,000 against the company, alleging that the death of the plaintiff was the result of silicosis caused by inhalation of dust. According to a statement in Rock Products a similar case had been won in the New York Court of Appeals (453).

In discharge of its duties under sections 101.01 to 101.28, inclusive, of the Statutes of Wisconsin, the industrial commission of that State issued (454) "General Orders on Dusts, Fumes, Vapors, and Gases," effective March 18, 1932; the following provision relates to dust:

> Order 2005--exhaust ventilation at source of contamination. -- Exhaust ventilation shall be provided in connection with all equipment and processes which create harmful exposure (order 2002) or any dusts, fumes, vapors, or gases in proportions which may be injurious to the health of any employee exposed thereto, except as

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provided in order 2012 and 2013. The exhaust ventilation shall be installed in a manner which will be effective in the removal of harmful dusts, fumes, vapors, and gases at the source to prevent their entrance into the breathing zone of an operator, or other persons in the vicinity, and to dispose of them in a manner so that they will not reenter any occupied area.

Exception. - Direct exposure to silica dusts, such as occur in most chipping, grinding, polishing, buffing, cleansing, and similar operations, is always hazardous in some degree. The degree of hazard, so far as it can be controlled, depends upon the concentration of fine (less than 10 microns in the longest dimension) silica dust and the length of time a person is exposed to the dust. It is the intent of this code to require the protection of persons exposed to silica-dust hazard by the provision of adequate exhaust ventilation at all those operations where it is practical or possible to capture the dust at the source. At those sources of harmful dust where it is definitely impossible or impractical to control the dust all persons exposed thereto shall be effectively protected by means of approved air-supply helmets. Masks or respirators may be used where approved in writing for specific operations by the industrial commission. However, there are at present some operations in foundries, such as the handling of molding sand and molds and the cleaning and dressing of castings, and in ceramic industries, where the effect and value of a strict application of the specified protective measures is somewhat in doubt. Therefore, with the understanding that employers will determine the nature and degree of all questionable hazards, will make every reasonable and practical effort to protect their employes at those operations, and will cooperate with the industrial commission in the establishment of safety measures to apply to such operations, such operations will not be subject to the provisions of this code until January 1, 1933.

Note - It is the intention to establish reasonable standards as applied to the above exempt operations during the 1-year period.

Order 2006 - protection from dusty operations. - The required exhaust ventilation for the protection of persons exposed to equipment and processes which create harmful dust shall be accomplished by the provision of appropriate hoods designed to catch all falling and deflected particles at the source, with duct connections to appropriate exhaust fans or other approved suction devices.

The following details of the industrial occupational-disease-schedule rating plan, released to manufacturers of Wisconsin effective April 1, 1933, were formulated by a subcommittee of the Wisconsin Compensation Rating and Inspection Bureau with the concurrence of the Industrial Commission of Wisconsin and the Wisconsin Compensation Insurance Board. The regulations apply to foundry operations and to stonecutting and polishing procedures, including carving and lettering. Industrial Medicine (455) mentions as of particular interest the specifications regarding dust counts which are listed according to the percentage of silica content of sand used and the dust particles less than 10 microns in size per cubic foot of air:

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These values are as follows: From 91 percent to 100 percent inclusive, 5,250,000; 81 to 90 percent, inclusive, 6,750,000; 71 percent to 80 percent, inclusive, 8,250,000; 61 percent to 70 percent, inclusive, 9,750,000; and from 51 percent to 60 percent, inclusive, 11,250,000. The dust particles are to be counted in accordance with the United States Public Health Service technic, and in making dust determinations a sufficient number of dust counts must be made, by an approved disinterested agency, to show representative conditions throughout complete cycles of dusty operations. The counts shall be made from samples taken from the normal breathing zone of the workmen at such times as will include the worst conditions and must cover at least one sample in specific operations outlined in the code, if such operations are present in the plant.

The rules of procedures governing the application of the industrial occupational-disease rating-schedule plan include the following principles:

1. The schedule may include all risks involving operations from which any form of occupational disease may arise.

2. The schedule is one of charges which are removable if established standards and requirements are met.

3. The number of charges and the amount of charge loadings may vary as between industries and classes of work.

4. In connection with risks wherein operations other than those subject to treatment of this schedule are performed the amount of the charge loadings shall be prorated in proportion to the employee-ratio of exposure.

5. The procedure respecting the period for which the rates resulting from this plan are available together with the procedure in connection with the making of surveys, interim surveys, and checking surveys shall be the same as that followed in connection with the application of the industrial compensation rating schedule.

6. The definition of the term "risk" shall be the same as that followed in connection with the application of the industrial compensation rating schedule.

7. The rates resulting from the application of this schedule shall be added to the adjusted rates or to the manual rates of the risk being rated, according to whether or not the risk is subject to treatment by the industrial compensation rating schedule and/or by the experience rating plan.

8. All tests to determine dust counts, chemical concentrations, and similar determinations shall be made by a disinterested agency (to be approved by the Wisconsin Compensation Rating and Inspection Bureau) in the presence of a salaried employee of the carrier or of the Wisconsin Compensation Rating and Inspection Bureau, the expense to be borne by the employer.

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There have been some interesting reactions from the inclusion of silicosis in workmen's compensation acts. After the all-inclusive occupational-disease amendment to the New York Workmen's Compensation Law was passed insurance companies notified the policy holders that their men must be examined for silicosis before the employers could obtain workmen's compensation insurance. When the president of the State federation of labor brought this matter to the attention of the Industrial Commissioner of New York State, the commissioner stated (456) that he considered this an extremely undesirable procedure for the following reasons:

> In the first place, from the standpoint of the cost of insurance, it makes the workers claim-conscious, and, more important still, it has a serious effect upon the morale of the men by exciting them about their physical condition. Then, too, if men are ruthlessly discharged, they, of course, have recourse to civil action against their employers because of the physical impairment which arose in the course of their past employment.
>
> As you know, these civil actions in the past have resulted in large awards to the workers or their widows or other survivors and have been a large drain upon the reserves of industry. This was one of the factors in the support given by industry to the silicosis bill enacted at the last session of the legislature but vetoed by the Governor because of the high rates which insurance companies said would have to be charged if the bill became law. Although it is true that workers who are members of labor unions have usually refrained from filing civil suits because to do so might have forced their employers out of business and also because the workers prefer wages to uncertain and delayed court awards, if a policy of physical examination and elimination of affected workers from employment is adopted by employers, either voluntarily or under the compulsion of their insurance carriers, it may be that these workers will follow the example of employees in open-shop plants in bringing civil suits. Such a development would be unfortunate in its effect upon industry, employment, and the morale and actual health of the workers. Physical examination of employees who have spent many years of their working lives in an industry would be justified if there were some method of compensation for those wage-earners who, while not disabled in the sense that they are unable to perform work, are found to be suffering from dust disease in some stage.***
>
> As to the alarm - real or assumed - with which some insurance companies are viewing the cost of coverage on risks where there may be a silicosis hazard after September 1, and the alarm they are spreading to their policy holders and through them to their workers, may I say that I consider this excitement greatly exaggerated. No workman on September 1 who was able to do a day's work on August 31 would quit work with the idea of bringing a claim before this department and receiving an award. Compensation awards can only be made when an employee is unable to work or else when he can prove he has a decreased earning capacity.

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In all probability there will be a silicosis bill introduced next January in the legislature and, if acceptable to workers and employers, will probably be passed. If this materializes, silicosis will only remain within the all-inclusive occupational-disease law from September 1 until early next year, and I cannot conceive how in that time there can be any greater number of claims for silicosis upon which awards would be made by this department and affirmed by the industrial board.

In the meantime it is for all of us who are interested in the prevention of dust diseases for the benefit of both industry and workers to do what we can to make prevention effective.

The results of following the procedure deemed "extremely undesirable" by the New York Commissioner of Labor are illustrated by a case occurring in Wisconsin in 1935; according to the Journal of the American Medical Association (457) a foundry company had to reinsure its employees. The prospective insurer demanded as a condition precedent to the execution of a policy that all employees be examined by a physician selected by it. Before the examination was made all employees were discharged. Only those were reemployed who were believed to be physically fit for the duties to be imposed on them. Five employees who were not reemployed, because they were not physically fit, were awarded compensation by the industrial commission, under the Wisconsin Workmen's Compensation Act. Thereupon their employer and its insurance carrier brought actions against the commission and the several claimants to set aside the awards. From a judgment modifying and affirming the award in each case the industrial commission, the several claimants, the employer, and the employer's insurance carrier appealed to the Supreme Court of Wisconsin. The Journal gives the decision of the court as follows:

The supreme court based its decision on the case of one claimant, Pernovich, as the same questions were involved in all cases. Pernovich, before he was discharged, had worked steadily. He was not aware that he was suffering from any disease. The physical examination, however, showed that he had had silicosis for probably 5 years or more and was in the second stage of that disease and that tuberculosis had already developed. Although at the time of the examination Pernovich was able to perform his work, his chance of recovery would be diminished if he remained in the dusty employment in which he had been engaged. Reexamination 3 months later showed that his ability to do work requiring physical exertion was greatly diminished, if he could be said to be able to do it at all. Nevertheless Pernovich's employer and its insurance carrier contended that he had suffered no compensable injury in the course of his employment with his employer, the foundry company.

Disability within the meaning of the statute, said the supreme court, occurs when an employee is disabled from rendering further service; that is, when he no longer has physical ability to perform his work in the usual and customary way. Unless he is so disabled he sustains no compensable injury even though in the course of his employment he is subjected to conditions that contribute to disability as an end result. The right of an employee to compensation depends on whether or not, in the course of his employment and because of it, an occupational disease renders him

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incapable of performing his customary work. It has been argued, said the court, that if an employee is entitled to compensation, as he is when he voluntarily ceases work because of physical incapacity to continue, then an employee who is discharged by his employer because of potential physical disability is equally entitled to compensation. For the latter contingency, however, the present law, which was framed to cover injuries resulting from accident, rather than incapacity resulting from occupational disease, affords no relief. An employee who has been exposed to industrial hazards, who has suffered no "physical disability" that prevents his performing his work in his usual and customary way, and who is discharged because an examination discloses that such disability may arise in the future, is not entitled to compensation for "medical disability."

It has been argued that it is against public policy to permit an employer to discharge an employee who has been exposed to industrial hazards, in order to anticipate his employee's future disability. That, however, said the supreme court, is a problem for the legislature and not for the courts. The courts can do nothing more than interpret and administer the statute. The remedy lies solely with the legislature. Finding no evidence to show that the claimants suffered disability within the meaning of the law during the period of their employment with the foundry company, nor until after the relation of employer and employee had been terminated, the judgments of the courts below in the several cases were reversed and remanded with instructions to enter judgments setting aside the awards of the industrial commission.

According to an insurance editor (458) "fear born of incomplete knowledge is the heart of the silicosis problem." He states that workmen's compensation insurance has been a headache to casualty-company executives for the past few years, although for the time, at least, the pressure has been lifted by the rise in industrial activity with an accompanying increase in pay rolls and premiums. Despite this, however, the future looks pretty dark to many, the reason given in two words is "occupational disease" and in one— "silicosis." In discussing the problem and the answer the editor states:

In considering the silicosis problem too often those affected have given way to semihysterical speculation on the possibility of disaster. Of course, the proper approach to an answer is to ascertain the known facts and from them consider the probabilities. The best program to bring about the least damaging of the probable developments can then be worked out, and an intelligent effort made to avert serious trouble. Let us first consider the picture as painted in its darkest tones by a partly informed and very worried insurance executive. He has been advised that 25 percent of all the industrial workers in the United States have silicosis in some degree. He has been told that silicosis is progressive, that there is no cure, and that death or permanent disability is inevitable. He sees, in many States, determined efforts to put silicosis under workmen's compensation, efforts that were successful, at the last session of the legislatures in New York and North Carolina. From past experience with the industrial commissions and other agencies administering the various compensation laws he has no confidence in their ability to distinguish between a workman

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disabled because of silicosis and a workman who, after exposure to silica dust, has X-ray indications of that exposure but no disability. Appalled by the possible accumulated liability, with the firm conviction that an effort to avoid all risks with a dust hazard will result inevitably in State compensation funds, he stands bewildered, waiting for the fast approaching storm to sweep away the compensation business. The final outcome may be as bad as, or worse than, is feared. If it is, the blame will be placed squarely on the shoulders of the industrialists and insurance men. Consider briefly the facts known about silicosis, as set forth by the best-known authorities. It is a disease of the lungs caused by the inhalation of large quantities of silica dust over long periods of time. In its early stages it is not disabling, and even in advanced cases disability or death is almost invariably due to some other infection of the lung, usually tuberculosis. A person with silicosis has less resistance to a tubercular infection than another with normal lungs, and an inactive tubercular infection may become reactivated by exposure to silica dust. Industry must remove tuberculars from occupations exposed to dust and will probably have to pay them compensation. The incidence of tuberculosis among those exposed to dust, outside of miners where other factors are largely responsible, is not alarmingly high. Modern engineering can reduce the dust hazard in any industry to the point where the occupation is perfectly safe for any worker whose lungs are free from infection when he begins work. Persons working under dusty conditions for years, who have developed some silicosis but not any infection, will probably never become disabled from this cause if the necessary protective measures are taken where they work. There is no medical evidence that silicosis causes the impairment of any other organ, such as the heart. The reserve lung capacity is so great that the lung can continue to function even though great masses of fibrous tissue have been formed as a result of silicosis.

With this in mind, take the hypothetical case of a foundry with 600 employees. Of these, 300 have been exposed to concentrations of dust varying from light in the case of furnace tenders to very heavy in the sandblast room. On medical and X-ray examinations it is found that almost 200 have some evidence of silicosis, with perhaps a dozen advanced cases uncomplicated by infection. Six have tuberculosis as well as silicosis. The risk is obviously dynamite, but the size of the explosion depends on how the situation is handled. The dust hazard in the plant must be cleaned up; to do this the cooperation of the employer is necessary. Then the employer will be expected to explain the exact state of affairs to the tubercular employees and send them to a sanitorium, with compensation paid to their families or dependents. Further, the men with advanced cases of silicosis will expect to be given light work within their capacity and kept on the payroll. The others can be left undisturbed, except that they should be required to take yearly physical examination; and all new employees will first undergo a complete examination. Such a program costs money, but if followed it will result in not only cleaning up a bad situation, but also in guarding against future trouble, and it is believed will in the end be less costly to the employer. On the other hand, if, after the results of the medical examination are known, the carrier gets off of the risk and does nothing, and the tubercular men are discharged, as well as those with advanced silicosis and some of the others,

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it is more than likely that the employer will be faced with suits which will turn the liability back on him and his carrier. At the same time the employer will find it impossible to get insurance from another company and he will join in the chorus of those shouting for a State fund. The big problem in silicosis is education. Manufacturers must be convinced that the hazard exists and that it must be eliminated. The medical profession, now woefully at sea, must learn how to diagnose silicosis and to determine the extent of disability, if any exists. Industrial boards and commissions must study the disease, its causes and effects, so that they will be in a position to make an intelligent decision on the medical evidence. The insurance companies must learn how to attack a risk which has a silicosis hazard, so that it may be made insurable, and how to handle it when it is insured. The refusal to write any risks with a dust hazard and the cancellation of any now insured will not solve the problem and will probably destroy the compensation business.

Sherman (459) has pointed out the lack of experience with compensation for silicosis or other dust diseases of the lungs under schedules in the United States - which foreign experience indicates calls for special terms and conditions to safeguard against impositions. He states that in Connecticut, Massachusetts, California, and Wisconsin the law nominally has long covered silicosis but in each of these States has had a peculiar history, significant enough to be noted in some detail.

In Connecticut (459) the original compensation law covered only injuries that happened at a definite time and place, that is, by accident. In 1919 the law was amended to abrogate that limitation and was then construed by the courts to cover all physical ill effects of working, whether resulting suddenly or gradually and whether the usual, expected, healthy or unhealthy accidents or conditions of employment, including the results of aggravations of ill health due to predisposition, preexisting diseases, vices, and bad habits or bad living conditions were immediate or contributing causes. The result was to stretch the compensation law far into the fields of ordinary health, invalidity, and life insurance, to induce an intolerable flood of claims, and to lead to a radical reaction. In 1927 the law was amended to cover only "accidental injuries" and "occupational diseases", to exclude all injuries unless due to employment "otherwise than through weakened resistance or lowered vitality", and to reduce the compensation benefits in cases of aggravation of preexisting diseases. The Connecticut law as amended has been operating quite smoothly to cover a wide range of diseases generally recognized to be "occupational", including silicosis; but the limits to its coverage and the conditions to the right to compensation under it have not yet been exactly defined and are still subjects for litigation and uncertainty.

In Massachusetts (459) the compensation law enacted in 1912 nominally covered all "personal injuries" arising from and in the course of employment; but the meaning and content of the term "personal injuries" was a subject of uncertainty and continual litigation until it was decided in 1929 that disablement from inhalation of silica dust is a compensable injury. Claims for compensation for silicosis, however, were rare until "claim consciousness" was aroused in 1933 by publicity given to the dismissal of 42 employees from a foundry at Taunton because upon medical examination they manifested incipient

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symptoms of silicosis or tuberculosis. Since then conditions in Massachusetts have been chaotic, to the distress of all parties concerned. Many employers are having difficulty in obtaining insurance because unable or unwilling to pay the price demanded by insurance carriers for silicosis coverage, whereas the insurance carriers are reluctant to provide such coverage at manual rates for fear they will prove inadequate. In the Defilippo case (460) the court held that "an insurer under the workmen's compensation act must take an employee as he may happen to be during the term of the policy."

Since 1918 the workmen's compensation law in California has covered "any injury", including a disease arising from and in the course of employment. During the earlier years under this law silicosis was popularly unknown, and by the time it began to be recognized old cases were barred by the requirement that a claim for compensation for an occupational disease must be made within 6 months after the first manifestations of symptoms of the disease. In 1930 the construction was liberalized to permit a claim within 6 months after disablement, and in 1933 the supreme court still further liberalized the construction by ruling that in case of a progressive disease, such as silicosis, a claim is timely if made within 6 months from the date when the employee first learned or reasonably should have known that his disability was due to such disease. That decision, according to Sherman (459), with its sweeping implications has stirred up a lively and widespread appreciation of the possibilities of gain through claims for disability from ill health attributed as an afterthought to exposures in employment. Consequently it may be stated that experience with compensation for silicosis in particular and other progressive "occupational diseases" in general is only beginning in California.

In Wisconsin (459) the workmen's compensation law covered only "accidental injuries" or "injuries by accident" until 1919, when it was amended to cover "occupational diseases." Notwithstanding this amendment, claims for silicosis were almost negligible in Wisconsin until 1931, when unemployment became widespread and numerous claims were instituted. With data available for losses under policies expiring in 1933, there is now about 3 years' experience to indicate the results of applying the Wisconsin law to compensation for silicosis; and such experience is alarming.

Two hundred damage suits (461), filed by former workmen against the contracting company that built the Hawk's Nest Tunnel in West Virginia on the ground that they had contracted silicosis while employed in the construction of the tunnel, were eliminated by the decision in two of the cases that a century-old statute of limitations of the Virginia code of 1819 required that the action be brought "1 year next after the right to bring the same shall have accrued and not after." (The action was instituted in October 1933; the time of employment was from April 1930 to September 1931.) Counsel for plaintiff asked for changes in the construction under "the rule of reason, the dictates of humanity, the principles of common justice, and the development and progress of the law in step with changing conditions." To this plea the court replied:

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> For more than a century legislatures, presumed to know the judicial construction of the statute, have ratified the construction by not amending the statute. It would be unwarranted for us at this late day to introduce by construction any innovation not authorized by the legislature.

According to a bulletin of the West Virginia Coal Association (462) rates charged subscribers in West Virginia for coverage in the workmen's compensation silicosis fund will be measured by the degree of exposure to the dust hazard with an allowance for dustproof equipment, including respirators.

Canada

"Miners' phthisis" was included in the list of compensable diseases enumerated in the Workmen's Compensation Act of Ontario in 1917. Its legal interpretation required the presence of silicosis with active tuberculosis in a miner; the first case was compensated in 1924. The silicosis provisions of the Ontario Mines Act and the Compensation Act were passed in 1926 (463). The schedule (464) includes miners' phthisis, mining; silicosis, mining; stone-workers' or grinders' phthisis, quarrying, cutting, crushing, grinding, or polishing of stone or grinding or polishing metal; pneumoconiosis, quarrying, cutting, crushing, grinding, or polishing stone or grinding or polishing metal. With regard to the two last-mentioned diseases (stone-workers' or grinders' phthisis and pneumoconiosis) provision was made in 1929 that "a person should not be employed in the cutting, polishing, or finishing of granite who is not the holder of a subsisting certificate given by a medical examiner under this act that such person is medically fit to be employed in such occupation." Certificates are issued for a definite period and renewed under prescribed conditions; there are also regulations for preventive measures by the employer. Provision is made for the extension of preventive regulations and of the act to include cutters, polishers, and grinders of any stone or substance other than granite by the minister of health with approval of Governor and council (464). The provisions of the Ontario act as amended to 1935 (465) follow:

> 113.—(1) Where a workman suffers from an industrial disease and is thereby disabled from earning full wages at the work at which he was employed or his death is caused by an industrial disease and the disease is due to the nature of any employment in which he was engaged at any time within 12 months previous to the date of his disablement, whether under one or more employments, the workman or his dependents shall be entitled to compensation as if the disease were a personal injury by accident and the disablement were the happening of the accident, subject to the modifications hereinafter mentioned, unless at the time of entering into the employment he had willfully and falsely represented himself in writing as not having previously suffered from the disease.
>
> (2) Where the compensation is payable by an employer individually it shall be payable by the employer who last employed the workman during such 12 months in the employment to the nature of which the disease was due.

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(3) The workman or his dependents if so required shall furnish the employer mentioned in the next preceding subsection with such information as to the names and addresses of all the other employers by whom he was employed in the employment to the nature of which the disease was due during such 12 months as such workman or his dependents may possess, and if such information is not furnished or is not sufficient to enable that employer to take the proceedings mentioned in subsection 4 that employer upon proving that the disease was not contracted while the workman was in his employment shall not be liable to pay compensation.

(4) If that employer alleges that the disease was in fact contracted while the workman was in the employment of some other employer he may bring such employer before the board and if the allegation is proved that other employer shall be the employer by whom the compensation shall be paid.

(5) If the disease is of such a nature as to be contracted by a gradual process any other employers who during such 12 months employed the workman in the employment to the nature of which the disease was due shall be liable to make to the employer by whom the compensation is payable such contributions as the board may determine to be just.

(6) The amount of compensation shall be fixed with reference to the earnings of the workman under the employer by whom the compensation is payable and the notice provided for by section 19 shall be given to the employer who last employed the workman during such 12 months in the employment to the nature of which the disease was due and the notice may be given notwithstanding that the workman has voluntarily left the employment (1914, c. 25, s. 100, 1-6).

(7) Where the compensation is payable out of the accident fund the board shall make such investigation as it deems necessary to ascertain the class or classes against which the compensation should be charged and shall charge or apportion the compensation accordingly (1917, c. 34, s. 17, 1).

(8) If the workman at or immediately before the date of disablement was employed in any process mentioned in the second column of schedule 3 and the disease contracted is the disease in the first column of the schedule set opposite to the description of the process the disease shall be deemed to have been due to the nature of that employment unless the contrary is proved, but -

(9) For the purposes of this act and notwithstanding anything to the contrary therein contained -

(a) "Silicosis" shall mean a fibrotic condition of the lungs caused by the inhalation of silica dust sufficient to produce a lessened capacity for work (1933, c. 70, s. 4).

(b) "Tuberculosis" shall mean tuberculosis of the lungs when on examination of any person

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(i) Tubercule bacillus is found in the sputum of such person.

(ii) Such person has active tuberculosis, shown by clinical and physical findings, to such a degree as to seriously impair his capacity for work (1933, c. 70, s. 4).

(9a) Any workman disabled from uncomplicated silicosis shall be compensated as for other industrial diseases under this act, but where a workman is disabled from silicosis complicated with tuberculosis, he shall be entitled to be compensated for total or partial disability on a basis for total disability of 50 percentum of his average earnings, as fixed by this act (1933, c. 70, s. 4).

(9b) Any workman who has heretofore ceased or may hereafter cease to be usually and regularly employed in an industry under this act in which he was exposed to silica dust shall make and establish his claim for disability therefrom within 2 years from the date of leaving such employment or 6 months after the passing of this act, whichever period is longer, or his claim shall be completely barred, but this provision shall not prevent allowance by the board of any case due to uncomplicated silicosis which the board consider should in justice be allowed (1933, c. 70, s. 4).

(9c) All claims for compensation for exposure to silica dust, which are outstanding at the time when this subsection comes into force and not already determined by the board, by reason of the death, from causes other than silicosis, or the disappearance or default of the workman, shall be deemed to be closed after the expiration of 2 years from the date of filing of such claim with the board, or within 6 months of the time of this subsection coming into force, whichever is the longer period, unless sooner determined by the board, and any assessment made or outstanding in respect of such undetermined claim, shall then be cancelled (1933, c. 70, s. 4).

(9d) The board is authorized to appoint such medical officers as may be required to carry out the provisions of the Mining Act and amendments thereto with regard to the examination of employees or applicants for employment, and the remuneration and expenses of such officers shall be paid out of the rates imposed for payment of silicosis claims (1928, c. 26, s. 5).

(10) Nothing in this act shall entitle a workman or his dependents to compensation, medical aid, or payment of burial expenses for disability or death from silicosis unless the workman has been actually exposed to silica dust in his employment in Ontario for periods amounting in all to at least 5 years preceding his disablement (1926, c. 42, s. 2).

(11) Nothing in this section shall affect the right of a workman to compensation in respect of a disease to which this section does not

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apply if the disease is the result of an injury in respect of which he is entitled to compensation under this part (1914, c. 25, s. 100, 8).

(12) The provisions of this section relating to silicosis shall apply also to pneumoconiosis and stoneworkers' or grinders' phthisis contracted during the course of employment in any of the processes in which penumoconiosis and stoneworkers' or grinders' phthisis is compensable as set forth in schedule 3 (1933, c. 70, s. 4, 5).

An interesting statement of the working out of the Ontario Mines Act has been published by G. O. Bateman, secretary of the Ontario Mining Association (464). Examination of all men in mines exposed to silica dust is required and all such workers must hold medical certificates certifying to freedom from tuberculosis of the respiratory organs, and compensation is provided for men affected by silicosis. According to Bateman -

This legislation was introduced as a result of a survey in Northern Ontario mining camps which indicated that silicosis had made alarming progress among the miners. There being no reason at that time to question the results of this survey, the operators agreed to do all that was asked of them and cooperated fully with the Government in the steps considered necessary to meet the situation.

When this legislation was first introduced in Ontario, we were advised that men with a moderate degree of silicosis, while not physically disabled, were better out of the industry and that they should be paid a lump sum which would assist them in rehabilitating themselves in some other occupation.

We were further advised that if we took active steps to clean up the situation then existing, pension the more serious cases, and remove men in the early stages of silicosis from underground, the situation would be well in hand, the first expense would be the heaviest, and that from then our liability would be practically limited to the anteprimary cases as they developed.

When the 1925 amendments were approved by the mines it was our understanding that men in the anteprimary stage had suffered no impairment of working capacity and that the $500 payment was a compassionate allowance for rehabilitation and not for disability. We further understood that with the payment of $500 to these men our responsibility in respect to them would be practically ended. It developed, however, that the legal position was different. The compensation board cannot make an award except for disability, and where disability has once been established the claimant can come back for review on evidence of further disability. It is generally accepted that silicosis predisposes a man to tuberculosis. It followed, therefore, that with secondary silicosis, as defined in the act, if any anteprimary silicotic at any future time and from any cause whatsoever developed tuberculosis, his condition was considered to be the result of his original disability and he was entitled to total disability compensation at an average cost of $12,000 per case.

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When, therefore, an award of $500 was made the compensation board immediately set up a prospective reserve for progression of an additional $11,500, with the result that we had an estimated liability to the end of 1932 of several million dollars, most of which was outstanding.

With the passage of time it also became apparent that the removal of the men from underground employment in the early stages of silicosis did not have the results anticipated. The payment of a lump-sum award did not in most cases serve the end expected. As a general rule, this money was expended for other things, and the men made little effort to rehabilitate themselves. A certain number of men classified as silicotic continued in their underground employment, and we found practically no difference in the rate of progression in those who continued as compared with those who were taken out of the mines. Some of this may have been due to the altered economic status, but even if the economic status had remained the same, we were forced to the conclusion that there was little if any benefit to the men by removing them from underground work, unless, of course, there was evidence of an onset of tuberculosis.

It should, of course, be understood that during this time active efforts were made by the mines to improve ventilation and to allay dust. Without this the above statement would not hold true. Steps were also taken by the mines to provide that men in the early stages of silicosis were placed where the conditions underground were most favorable.

Our experience also indicates that the early stages of silicosis do not necessarily mean an impairment of working capacity. This is all the more important on account of the difficulty of diagnosing silicosis in its early stages, as there is no sharp line of demarcation between the preanteprimary and the anteprimary, or between anteprimary and primary stages, and, as a matter of fact, we believe that there is a great deal more uncertainty in the diagnosis of silicosis than the medical men are willing to admit. The determination is largely a matter of personal judgment and therefore subject to error.

A great deal of what may be read into an X-ray film depends upon the technic in taking the film. Certain other diseases and chest conditions will also give in the film an appearance simulating that of silicosis, and we believe it is safe to say that without a definite knowledge of occupational history the diagnosis of silicosis in its earlier stages would be practically impossible.

In view of these conditions, it was felt that the industry was carrying an unfair burden, and in 1933 the act was amended. The anteprimary and primary classifications were deleted, compensation was made payable only for disability, which means actual impairment of working capacity, men with a moderate degree of silicosis were allowed to continue underground work, and the industry was relieved from unlimited liability in respect to progression by providing that the claimant must make and establish his claim for disability within 2 years of leaving the employment, at which he was exposed to dust, to entitle him to compensation.

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As I said before, silicosis is essentially an employer's problem. It is in many places an important item in his cost of production, and to a considerable degree it is a controllable item of expense. If the employer simply leaves the matter in the hands of the doctors, he will have no one to blame but himself over what it costs him. The opinion of the ordinary practitioner and even of the roentgenologist and expert chest and lung man may be of little value. Only the opinion of those doctors who have had special training in the diagnosis of silicosis from both clinical and X-ray examinations should be accepted, and even those opinions cannot be accepted in all cases.

We do not say this with any intention of criticizing the members of the medical profession, but where the matter is so important and costly to industry, where so little is actually known about the disease, and where there is still an element of uncertainty in the diagnosis of silicosis in its earlier stages, too much care cannot be exercised, and the closest scrutiny by industry which has to pay the bills is most necessary. The best results can only be obtained by the employers and the doctors working together, but the employer must consider it as one of his particular problems.

In 1933 the Ontario Workmen's Compensation Act was amended to permit the board to adopt a merit rating system and to authorize it to reduce the assessments of an employer who had a good accident record (466). The section of the act providing compensation for disability due to silicosis was amended to fix the basis for total disability at 50 percent of the average earnings in cases where silicosis is complicated by tuberculosis. All claims are barred if the workman does not establish his claim within 2 years after leaving employment in an industry in which he was exposed to silica dust or within 6 months after the passage of the amending act, whichever period is longer. The board is authorized to allow any case of disability due to uncomplicated silicosis which it considers compensable. These provisions relating to silicosis may be extended to cover pneumoconiosis and stoneworkers' or grinders' phthisis, upon proclamation of the Lieutenant Governor in council.

The principal change in the Quebec act was the elimination of silicosis, pneumoconiosis, and several allied diseases from the schedule of industrial diseases. The silicosis Act of 1931 was repealed (466).

In 1928 silicosis was designated in the Alberta Workmen's Compensation Act (467) as "pneumonoconiosis which shall be deemed silicosis, siderosis, lithosis in quarrying, cutting, crushing, grinding, or polishing of stone or grinding or polishing of metal (mining)."

The provisions for compensation of silicosis in Saskatchewan (467) are virtually the same as for Ontario except for the following addition regarding tuberculosis:

(8) "Tuberculosis" shall for the purposes of this act mean tuberculosis of the respiratory organs when on examination of any person it is found that:

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(a) Such person expectorates the tubercle bacillus,

(b) Such person has closed tuberculosis to such a degree as to seriously impair his working capacity and to render prohibition of his working underground advisable in the interests of his health.

In summarizing the status of silicosis compensation in Canada attention is called to the fact (467) that of nine provinces that have enacted workmen's compensation laws seven include an enumerated list of compensable occupational diseases but in only 3 - Alberta, Ontario, and Saskatchewan - are silicosis and other pneumoconioses specifically scheduled. However, although they do not specify silicosis as a compensable disease the Workmen's Compensation Acts of Nova Scotia and British Columbia permit the worker to claim compensation for disease due to occupation as though it were a compensable injury (463).

In 1929 a bill was introduced in the Legislature of Manitoba providing for compensation and prevention of silicosis but was set aside pending the recommendations of a general committee considering the existing workmen's compensation act. In the meantime the mines department drafted rules to control the dust hazard and tuberculosis in mines, and the provincial department of health established a clinic for the examination of gold miners to determine whether silicosis was present. This was the status in 1930 (463).

Great Britain

Silicosis was not included in European laws in the earlier schedules of occupational diseases, although what is now called silicosis was recognized early in South Africa (466). In Great Britain compensation for industrial diseases was granted first under the Workmen's Compensation Act of 1906 (468). This act contained a schedule or list, and any disease placed on this list became an accident under the meaning of the act. Owing to its chronic character and other differences from most occupational diseases, silicosis was never placed on this list. A special act, the Workmen's Compensation (Silicosis) Act, was passed in 1918 granting compensation in those industries to which the act should be made applicable at any time. This was modified in 1924 and finally absorbed into the Consolidating Workmen's Compensation Act of 1925 as section 47.

The numerous occupations in which silicosis is known positively to occur are covered for compensation purposes by one or other of the silicosis orders made by the Secretary of State under powers conferred upon him by section 47 mentioned above) which follows (469):

47. - (1) The Secretary of State may by scheme provide for the payment of compensation by the employers of workmen in any specified industry or process or group of industries or processes involving exposure to silica dust -

(a) Who are certified in such manner as may be prescribed by the scheme to have suffered death or total disablement from the disease known as fibroid phthisis or silicosis of the lungs (in this section referred to as silicosis) or from that disease accompanied by tuberculosis; or

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(b) Who, though not totally disabled, are found on medical examination to be suffering from silicosis, or from silicosis accompanied by tuberculosis, to such a degree as to make it dangerous to continue work in the industry or process, and are for that reason suspended from employment.

(2) The scale of compensation fixed by the scheme in the case of death or total disablement due to silicosis or silicosis accompanied by tuberculosis shall be that prescribed by this act and in any other case shall be such as may be prescribed by the scheme.

(3) Provision may be made by the scheme -

(a) For the establishment of a general compensation fund, to be administered either through a mutual trade insurance company or society of employers, or in such other manner as may be provided by the scheme

(b) For requiring employers to subscribe to the fund, and for the recovery of such subscriptions, and for the payment and recovery out of the fund of all compensation under the scheme, and of any expenses arising under the scheme which are directed by the scheme to be so paid, subject to such exceptions in special cases as may be made by the scheme

(c) For the settlement of claims and other matters arising under the scheme by committees representative of both employers and workmen, with an independent chairman, and for the procedure to be adopted before such committees

(d) For the appointment and remuneration of medical officers, medical boards, and advisory medical bodies, and for their duties and powers in connection with the scheme

(e) For requiring workmen to whom the scheme applies (i) to submit themselves to such periodical medical examination, and (ii) to furnish such information with respect to their previous employment in any industry specified in the scheme, as involving exposure to silica dust, as may be prescribed by the scheme, and for making the right of the workmen to compensation conditional on compliance with such requirements, and for the suspension from employment of workmen who are found at any time to be suffering from silicosis or tuberculosis, or silicosis accompanied by tuberculosis, or who, when first medically examined in pursuance of the scheme, are found unsuitable for work in the industry or process by reason of their failure to satisfy such requirements with respect to physique as may be prescribed by the scheme; and

(f) For the application with the necessary modifications of any of the provisions of this act, or of any enactment relating to compensation thereunder, and for defining the industries or processes to which the scheme applies, and generally for such further or supplemental matters, including provisions as to the determination of disputes arising between

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employers and the authority administering the fund, as appear necessary for giving full effect to the scheme.

(4) Any scheme made under this section may be extended or varied by any subsequent scheme made in the like manner and shall have effect as if enacted in this act, but any scheme made under this section shall be laid before each House of Parliament forthwith, and, if an address is presented to His Majesty by either House of Parliament within the next subsequent 21 days on which that House sits next after any such scheme is laid before it praying that the scheme may be annulled, His Majesty in Council may annul the scheme, and it shall thenceforward be void, but without prejudice to the validity of anything done thereunder.

(5) Section one of the Rules Publication Act, 1893, shall not apply to any scheme made under this section.

The first compensation scheme for silicosis was made for the refractories industries in 1919, under the Workmen's Compensation (Silicosis) Act of 1918, and became effective February 1, 1919. The present scheme, made under the Acts of 1918 and 1924, became effective May 1, 1925 (469). The Refractories-Industries Scheme of 1925 covers all processes in or in connection with acquiring and manipulating refractory material containing not less than 80 percent total silica (470). According to Collis (468) the 80-percent limit is adopted to delimit the industries and has no reference to a danger limit in the silica content. The other occupations mentioned in the first schedule to the scheme are Metal-Grinding Industries (Silicosis) Scheme, 1927; the Various-Industries (Silicosis) Scheme, 1928; and the Sandstone-Industry (Silicosis) Scheme, 1929 (469). The Metal-Grinding-Industries Scheme, 1927, covers grinding metal or any article of metal on a grindstone or metal wheel composed of natural or manufactured sandstone, including the processes of racing, hacking, and rodding such grindstones and any processes incidental thereto, and polishing, if done in the same room as such grinding (469). The Various-Industries Scheme, 1928, makes special provision for: (a) Certain processes in the manufacture of china and earthenware, including electrical and sanitary earthenware and earthenware tiles; (b) crushing, grinding, and handling silica rock in steel works and foundries, including freeing castings from siliceous substances and sandblasting metals; (c) dressing granite (including any igneous rock) by masons for building, engineering, and monumental purposes; (d) drilling and blasting stone by hand or power-driven machines in any colliery, including handling such stone; (e) any process underground in tin mines and manipulation of the ore at the surface. In addition to these special provisions, general provision is made in this scheme for a very large number of industrial processes which involve handling or manipulating, in one form or another, silica rock, dried quartzose sand, or flint (469).

The Sandstone-Industry Scheme, 1929, covers all processes in and incidental to quarrying and manipulating sandstone (including gritstone, ganister, and quartzite) which are carried out at or in connection with a quarry (469). The following provisions of the Sandstone-Industry Scheme illustrate some of the requirements of compensation laws in Great Britain (470):

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A workman employed in the industry on or after the 1st April, 1929, or, in case of death, his dependents, will, subject to what is mentioned below, be entitled to compensation if the medical board certify either -

(1) That the workman's death was caused by silicosis or silicosis accompanied by tuberculosis; or

(2) That the workman is totally disabled for work in the industry by silicosis or silicosis accompanied by tuberculosis; or

(3) That the workman, though not totally disabled for work in the industry, is suffering from silicosis or silicosis accompanied by tuberculosis to such a degree as to make it dangerous for him to continue work in the industry and is for that reason suspended from employment.

The disease must be due to employment in the industry, but if the workman has been employed in the industry for a period or periods amounting to not less than 5 years the disease will be deemed to be due to employment in the industry, unless the employer or the company proves the contrary.

No compensation will be payable -

(1) If the medical board certifies that the silicosis cannot have been contracted in the industry owing to the shortness of the time during which the workman has been employed therein

(2) In cases where the workman has not been employed in the industry or in receipt of weekly payments under this scheme at any time within the 3 years previous to disablement or death

(3) In cases where the workman, or his dependents, as the case may be, are in receipt of compensation under any other scheme or enactment providing compensation for silicosis whether in Great Britain or elsewhere

(4) In cases where the workman has left the industry, unless it is proved to the satisfaction of the joint committee that since his last employment therein he has not been employed in any of the occupations specified in the first schedule of this scheme.

The workman will also be liable to forfeit any right to compensation if he fails to carry out his duties under the scheme.

Paragraph 47 of the scheme provides that every workman shall be supplied by his employer with a register in the prescribed form, which shall be renewed when necessary by the employer and in which shall be entered -

(1) The date of commencement of his employment with that employer, and the name of the employer and address of the works (to be entered by the employer).

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(2) Particulars as supplied by the workman of any previous employment in the sandstone industry or in any of the occupations mentioned in the First Schedule to this scheme (to be entered by the employer and signed by the workman)

(3) The date on which the workman enters any new employment in the sandstone industry and the name of the new employer and address of the works (to be entered by the new employer)

(4) The date of any medical examination made in pursuance of the scheme and the result of the examination (to be entered by the medical officer making the examination).

This register must be kept by the workman and produced when required by the employer or by the medical board or other appointed medical practitioner for the purpose of carrying out any of their duties under the scheme, and a duplicate of it must be kept by the employer and forwarded by him, when the workman leaves the employment, to the medical board.

The Various-Industries Scheme affects especially the mining industry (469). This scheme provides that if a workman has been employed in the processes named for a period or periods amounting altogether to 5 years or more he shall be assumed to have contracted silicosis unless the employer proves that he has not. Compensation is not payable under three conditions: (1) If the medical board certifies that silicosis could not have been contracted owing to the shortness of time of employment in the processes; (2) if the workman has not been employed in the processes or has not been in receipt of weekly payments under the scheme at any time within 3 years previous to the date of disablement, suspension, or death; and (3) if compensation is being paid under another scheme (469).

Dissatisfaction with the scheme developed when it was found that the provisions of the schemes failed to cover cases of disability from fibrosis arising from conditions of employment in coal mines for which compensation should be allowed. At a conference on June 16, 1934, the Miners' Federation presented a strong case for amendment of the existing compensation scheme on the two main grounds that it did not cover a large number of cases which should be compensated and that the procedure necessary to substantiate a claim was unduly difficult and costly for workmen (471). The federation submitted particulars of a number of cases certified as suffering from silicosis but who, as far as could be determined, had never been employed in the occupations specified in the scheme and suggested that the scheme be extended to cover all underground employment. The home secretary agreed that something must be done to remedy the condition, but the choice of the best method presented many difficulties.

In July 1934 in a general debate in the House of Commons Grenfell (471), in referring to the silicosis orders under the workmen's compensation act, said that a large number of workmen had been disabled and a large number had died in the industry week by week, yet no compensation was obtainable by the disabled persons or, in case of death, by their dependents. He also said that in the South Wales coal field alone more than 200 men had been certified as suffering from silicosis

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who could not qualify for compensation under the terms of the order and complained that the employers had not assisted in making provision for the disabled men but had persistently and determinedly opposed and obstructed such action, although they had begun to recognize that it was their duty to provide compensation for these men. He stated further that the essential condition in safeguarding the interests of these men was to eliminate from the order all reference to processes and conditions of labor, leaving as the sole condition that the men had been employed in a coal mine and had been certified as disabled by silicosis.

A few of the many instances of the practical application of the law which caused dissatisfaction among British miners follow:

Workmen's compensation: Silicosis claim dismissed. - The Carron Co., Carron, Stirlingshire, were successful in their defense to a claim for silicosis under the workmen's compensation acts in Falkirk Sheriff Court recently. Proceedings under the acts and the Silicosis (Various-Industries) Scheme, 1931, were brought against the company by Robert Ferguson, a colliery worker. He founded on a certificate by the medical board appointed under the scheme granted on December 14, 1932, which certified that though not totally disabled the workman was suffering from silicosis to such a degree as to make it dangerous for him to continue to work in the industry or process of stone drilling and blasting in a narrow working in a coal mine. The board also certified that the general physical capacity of the workman for employment was impaired by reason of the disease of silicosis which was in the first stage; that there was a medium degree of impairment of the general physical capacity for employment; and that the man was only fit for light work. The employers repudiated liability on the ground that the workman had not been employed in any of the processes defined in section 2 of the scheme and that he had not been exposed to the dust of silica rock. At the proof in the proceedings the claimant gave evidence to the effect that he worked as a miner at the face, bringing down coal which was undercut by the machine; that there was an ironstone roof containing silica; that holes had to be stamped in it to permit of the erection of props for the machine to bore shot holes; and that sometimes in boring a hole in the coal the drill penetrated the stone roof at the extremity of the hole. It also appeared from the evidence that occasionally ironstone balls were met with in the coal and that the drill in boring them frequently came against them, some witnesses alleging that they bored through them. A geologist who gave evidence based on an analysis of the strata said that the amount of silica in these ironstone balls was negligible. On the evidence it was maintained for the claimant that he had been drilling and blasting in silica rock within the meaning of paragraph (2) of the scheme, and being in possession of a certificate of partial disablement he was entitled to compensation at a partial rate. Among several points taken by the employers' solicitor was one to the effect that the claimant was not employed to drill or blast silica rock and that the tools he used were only for blasting in coal and not in stone.

Sheriff Robertson has dismissed the claim. He holds that the claimant has failed to prove that there was any silica rock in the mines in which

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the workman was employed by the company or that he was employed in drilling or blasting in such rock in these mines or in any other process mentioned in the scheme. His lordship, therefore, holds in law that the claimant has failed to prove that he is incapacitated as the result of personal injury by accident within the meaning of the workmen's compensation acts. In a note to his considered judgment, the sheriff observes that the claimant was employed as a coal miner purely and simply; he was not employed to drill or blast or work in stone in any manner of way. Apart from this, it had been proved that such rock as there was in the mine, of which samples were taken at the sight of both parties and analyzed, was not silica rock. According to section 2 (1) of the order, silica rock meant quartz, quartzite, ganister, sandstone, gritstone, and chert. The evidence of Dr. Tyrell, an eminent geologist, called by the claimant, was to the effect that these rocks had a common characteristic, viz., that they were predominantly, if not entirely, composed of silica. None of the rocks examined by him fell within the categories given. According to him none of them was what was technically known as silica rock. The evidence he gave of the results of his analysis confirmed this. That was enough for the disposal of the case (472).

Silicosis appeals in the House of Lords. - Two appeals, which were said to affect a number of other workmen employed by Amalgamated Anthracite Collieries, Ltd., as well as the two appellants, were before Lord Atkin, Lord Tomlin, and Lord Russell of Killowen in the House of Lords this week. Thomas Morgan and John Hutchins appealed against a judgment of the court of appeal affirming an award made by the arbitrator, his Honor Judge Davies, at Neath and Port Talbot County Court, in favor of respondents to the appeal, the Amalgamated Anthracite Collieries, Ltd.

Sir Stafford Cripps, K.C. (for appellants), said they both contracted silicosis and had been certified by the medical board as suspended from employment. A number of other men besides the present appellants were affected by the court's decision because they were certified to be suffering from silicosis. He (counsel) asked their lordships to determine whether the employment of the appellants was one within the Various-Industries (Silicosis) Scheme, 1931, or, alternatively, whether the disease from which they were suffering was a personal injury by accident within the meaning of the Workmen's Compensation Act, 1925. They worked underground at respondents' Tirbach colliery and contended that their disease was due to the nature of their employment in processes specified in the Various-Industries (Silicosis) Scheme.

His Honor Judge Davies found that there were intermittent veins, or lenticles, of silica in the colliery within the meaning of the scheme, but that there was no drilling or blasting where the lenticles were present, and that the silica lenticles or veins had nothing to do with the silicosis from which appellants were suffering. He also found that appellants were constantly exposed to silica dust from the shale, but that the dust was from something that was not silica rock and that appellants, therefore, did not come within the words of the scheme which would have entitled them to compensation.

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There was no evidence, Sir Stafford urged, upon which the judge could properly find that appellants had not, during their employment been exposed to the dust of silica rock. He submitted that shale was a dry deposit or dry residue of silica within the meaning of the scheme. After the commencement of the Various-Industries (Silicosis) Scheme, 1931, appellants were employed in one or more of the processes specified in that scheme and the disease from which they were certified to be suffering was due to their employment in these processes. He submitted that Judge Davies and the court of appeal were wrong in deciding to the contrary.

Sir William Jowett, K.C., for respondents argued in support of the findings of the arbitrator's award. He submitted that appellants had not proved that they worked in the processes specified in the Various-Industries (Silicosis) Scheme, 1931, or that they had been exposed to the dust of silica rock. The questions for decision by Judge Davies were, he said, questions of fact, and he contended there was evidence to support each finding of fact made by that judge. Sir William Jowett went on to argue in support of the further finding of Judge Davies, after the matter had been remitted to him by the court of appeal, namely, that the shale above the coal in the Big Vein was not a dry deposit or dry residue of silica or a dry admixture containing any of the materials specified in the scheme, and that the work done by appellants in shale was not a process within the meaning of the scheme.

Judgment was reserved (473).

Workmen's compensation: Silicosis. - A judgment delivered in the House of Lords, on July 17, decided that two workmen named Morgan and Hutchings, who had been certified as suffering from silicosis, were entitled to be paid compensation by their employer, the Amalgamated Anthracite Collieries, Ltd., of Swansea.

His Honor Judge Frank Davies, acting as arbitrator under the Various-Industries (Silicosis)Scheme, 1931, had decided against the men's claim broadly on the ground that the work upon which they were employed at Taibach colliery, did not bring them within the meaning of the words contained in the scheme. The court of appeal affirmed the view taken by the arbitrator, and the workmen appealed to the House of Lords against the judgment of the court of appeal.

Lord Atkin, giving the judgment of the House of Lords, found that the applicant had been employed in drilling or blasting in stone, namely shale, and the employer had discharged the onus of proving under a proviso that the workman had not, during the employment, been exposed to the dust of silica rock. The judge was not satisfied that when the silica lenticles fell in blasting any dust was caused by them. It is not necessary, said Lord Atkin, that the dust of silica rock should be the dust of silica rock which is being at the time reduced to dust by the workman's operations. The workman was in fact being exposed to the dust of silica rock - the free silica in the shale which is truly the dust of quartz. The House

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of Lords must find that the applicant was a workman to whom the scheme applied. If the words "disease due to employment in the process" in the scheme meant that the process alone must produce the dust the workman must fail. But their lordships thought the scheme itself showed that the words were used in a much more general sense. For the employer's benefit there was a proviso that he was not to be liable if he proved that the workman had not "during the employment to which the disease is alleged to be due been exposed to the dust of silica rock." The proviso conveyed that though the stone was not silica rock, yet if "during the employment" the workman was exposed to silica dust - something other than the dust of the stone to which the process was related - the employer might be liable.

His lordship thought, therefore, that if the workman's employment was such that he was from time to time employed in a specified process, but by reason of that employment of which the process formed a part he was exposed to silica dust and contracted the disease, he was entitled to compensation. The appeals therefore succeeded. The award of the judge, dated March 10, and the order of the court of appeal of June 11, 1934, were set aside and the case was remitted to the county court judge for him to award compensation and deal with certain costs. The appellants were given costs of a second appeal to the court of appeal and of the appeal to the House of Lords (474).

On September 1, 1934, a new order, known as the Silicosis and Asbestosis (Medical- Arrangements) Amendment Scheme, came into force with the following provisions (475):

The alterations to paragraph 12 of the scheme require an employee of 21 years of age or over to submit himself for medical examination unless he has already worked for 3 years in a process included in the schedule to the scheme. If the workman is found to be suffering from the disease or from tuberculosis, he must be referred to the medical board, who, if satisfied, may suspend him from further employment in the industry. A workman under 21 years of age must submit himself for examination and satisfy the examiners that his chest is of average development and the respiratory passages are free from obstruction, there are no signs of disease of the heart, and no tuberculosis of any region, unless he has previously been examined and found satisfactory under the scheme. The requirements of paragraph 12 of the scheme will not apply to a person employed in any of the processes carried on in the pottery industry included in the first schedule to that scheme who is under the age of 21 years and who, on initial examination, has been found to satisfy the requirements relating to physique given above. A new schedule is substituted for the original one and contains particulars of the industries and processes included in the refractory industries, the sandstone industry, the pottery industry, and the asbestos industry, to which the act applies.

On October 22, 1934, the home secretary made a further scheme under section 47 of the Workmen's Compensation Act, 1925, which extends the Various-Industries (Silicosis) Scheme, 1931, to cover employment in any operation underground in

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a coal mine. The order applies to workmen employed in any such operation at any time on or after the date of the order (476).

The British home secretary's order of January 29, 1935 (477), extended the Various-Industries (Silicosis) Scheme, 1931, to cover employment in any operation underground in hematite iron-ore mines. The order was issued under the workmen's compensation acts and went into effect March 1, 1935.

Although the silicosis schemes vary in minor particulars (478) the general plan is for every newcomer to be examined by an expert medical board before being allowed to work and then examined periodically thereafter. Any worker found developing dust trouble, although not incapacitated, is warned of his condition and may claim partial compensation while seeking other employment; anyone found with pulmonary tuberculosis is prohibited from further work and granted compensation, the idea being to protect others as well as the one examined. Workers in the more dangerous processes of the refractories and sandstone industries are examined every 18 months and in the less dangerous processes every 3 years, those in the pottery industry at intervals of 18 months and those in the asbestos industry yearly.

The preventive aspect of the silicosis schemes lies in their power to set up a standard of physique for all new entrants into these industries, based upon periodic medical examinations (464).

South Africa

The Miners' Phthisis Compensation Act of South Africa became effective on August 1, 1912 (468); it was preceded in 1911 by a scheme granting compensation for silicosis. The many investigations made and experience gained have lead to changes in the law; further measures were passed in 1916, 1917, and 1919, and finally in 1925 the present act, known as the Miners' Phthisis Acts Consolidation Act, became effective.

Mavrogordato (479) states that in 1911 25 percent of the employees contracted silicosis, developing symptoms within a couple of years; in 1917 only about 6 percent of the workers were affected, developing symptoms in less than 9 or 10 years; and in 1922 less than 3.5 percent of the men employed contracted silicosis, developing symptoms in 9 to 10 years. He pointed out in 1925 that the results of "dust surveys" in 1915, registered by the gravimetric method, showed an average of 4.9 mg of dust per cubic meter of air, whereas in 1919 the average had fallen to 2.9 mg. and in 1923 to only 1.3 mg.

Collis (468) has summarized the status of the compensation laws of South Africa as follows:

> The principles adopted at an early stage and developed in South Africa have been to establish a compensation fund and to entrust to a medical bureau all purely medical questions bearing upon compensation.
>
> The compensation fund is levied by a miners' phthisis board from employers of definite scheduled mines wherein the mineral dust produced by mining operations is held to be of such a nature as to cause silicosis.

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The total levy to be made by the board in any year depends upon the total compensation costs. The amount each employer pays is assessed as follows:

Section 41. - (2) (a) Thirty percent of the amount in proportion to the earnings in a scheduled mine during the previous period of 3 months of the miners employed by such employer,

(b) Fifty percent of the amount in proportion to the silicosis rate for each mine,

(c) Twenty percent of the amount in proportion to the sum for which such employer was assessed for normal income tax.

The Miners' Phthisis Medical Bureau is (I) to examine all men of European origin applying for work underground and to grant an initial certificate if the applicant is free from any disease of the lungs and respiratory organs and is in other respects physically fit for underground work; (II) to examine every 6 months all European miners; and (III) to examine from time to time men suspended from employment and awarded compensation.

The purpose of the 6-monthly periodical examination is the detection and notification of all cases of the three compensable diseases, "simple silicosis", "tuberculosis with silicosis", and "simple tuberculosis", which exist amongst the working miners.

By "simple silicosis" is meant silicosis without a definitely recognizable or "overt" tuberculosis; by "tuberculosis with silicosis" is meant silicosis with overt tuberculosis; and by "simple tuberculosis" is meant tuberculosis of the respiratory organs without detectable silicosis.

For compensation purposes the stages of disease are graded and a miner is deemed to have silicosis:

(a) In the anteprimary stage when it is found that physical signs of damage to the lungs, short of definite physical signs of silicosis, have become evident and that such damage has supervened during and in consequence of employment in a scheduled mine,

(b) In the primary stage when it is found that definite and specific physical signs of silicosis are or have been present and that capacity for work is or has been impaired by that disease, though not seriously and permanently,

(c) In the secondary stage when it is found that definite and specific physical signs of silicosis are or have been present and that capacity for work is or has been seriously and permanently impaired by the disease.

Cases in the anteprimary and the primary stages are granted benefit in one lump sum, calculated according to a schedule in relation to wages earned. * * *

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Cases in the secondary stage are not given a lump sum, but are awarded a monthly pension calculated according to wages earned. ***.

If a miner at a periodical examination is found to have tuberculosis with silicosis, or simple tuberculosis, he is obliged to relinquish underground work immediately. If he is found to have simple silicosis, it is optional for him to take an award and leave underground work or to remain at work and postpone taking an award. Should the miner, however, remain at work underground, for a period of longer than 3 months after receipt of a notification that he has silicosis, he forfeits, during his lifetime, all right to an award, other than that to which he would have been entitled at the date of his first notification.

If a miner is suspended for "tuberculosis", not complicated by silicosis, he benefits as if he was found to have silicosis in the primary stage. This action is justified on two grounds; first the initial examination is so strict that anyone passing it and subsequently contracting simple tuberculosis may be held to have become infected during his period of employment, and possibly due to it; and, secondly, although he may not be incapacitated, he has become a potent source of danger to others, and for this reason must be suspended and compensated.

The expression "tuberculosis" is defined to mean tuberculosis of the lungs or of the respiratory organs, and a person is deemed to be suffering from tuberculosis whenever it is found either -

(a) That such person is expectorating the tubercle bacillus; or

(b) That such person has closed tuberculosis to such a degree as to impair seriously his working capacity and to render his removal from underground work advisable in the interests of his health.

If tuberculosis is found associated with silicosis at any clinical stage, the case becomes for compensation purposes one of secondary silicosis.

A medical board of appeal has been established under the 1925 Act to consider cases of dissatisfaction on medical grounds with decisions given by the Medical Bureau.

Native laborers. - Compensation, based on wages as stated above, is also awarded to native laborers who outnumber European miners by about 10 to 1. Mine medical officers - not the Medical Bureau - are responsible for natives, both for initial examination and for periodical supervision.

Periodical supervision is exerted (a) by weighing short-service natives every 6 months, when any man who has lost 5 pounds in weight is set aside for a medical overhaul; and (b) by medically examining once every 3 months, and by submitting to radiographic examination once every year, each native of 5 years' service. Any native suspected by a mine

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medical officer of having silicosis or tuberculosis is sent forward for a "benefits" examination by the medical bureau.

Although the period of work of native laborers is gradually lengthening, few remain exposed to risk long enough to contract silicosis; but they quickly contract simple tuberculosis in an acute form and become a source of infection for the silicotic Europeans.

Other Countries

A number of other countries include silicosis in their compensation laws, but these laws are based more or less on those of Great Britain and South Africa and need not be considered in detail here.

In Australia (480) the Workmen's Compensation Act of 1920 provides for compensation of workers disabled by silica or other dusts. Workmen at Broken Hill mines are compensated by a special Workmen's Compensation (Broken Hill) Act of 1920-1927. At Broken Hill (481) a Bureau of Medical Inspection of the Department of Labor and Industry of New South Wales examined all applicants for work in the mines. The medical boards, which sit at the bureau, deal with applications for compensation for both dust diseases of the lungs and lead poisoning. There are three medical practitioners on each board - one appointed by the mine owners, one by the mine workers, and an independent chairman, the officer in charge of the bureau.

Under the system of medical examination at Broken Hill a man obtains a job at a mine and is given a ticket to report at the bureau for medical examination, but if he fails in this he never starts work; whereas at Kalgoorlie, Western Australia, a man looks for work with a certificate of fitness which he has previously obtained. - a system similar to that employed on the Rand - undoubtedly a great number of superfluous examinations are thus made (481).

Germany added silicosis - "serious pneumoconiosis" - to its schedule in 1929. At present various dust diseases of the lungs, specifically named, of which silicosis is the most prominent, when occurring in specified occupations or under specified conditions, are compensable, either under general compensation laws or under special schemes or statutes, nearly always subject to special regulations and safeguards, in the following countries: Bulgaria, Czechoslovakia, Denmark, Sweden, Switzerland, Russia, Argentina, Bolivia, Brazil, Chile, and Mexico. Under some of the special statutes the state contributes to the cost (459).

Section 4. - Cost of Compensation for Silicosis

The cost of compensation for silicosis had been negligible in the United States until the so-called silicosis "racketeers" began to sue in the courts and collect such large damages that the existence of some of the dusty industries was threatened. Therefore most of the information regarding the cost of legal compensation for silicosis must be obtained from countries - especially those of the British Empire - that for many years have included this disease in occupational-disease compensation schedules. Keiser (442) believes that the trend of silicosis compensation indicates that the legal measures employed in other countries, particularly those for compensation of mine workers, will be adopted in the United States.

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The following statement by Industrial Commissioner E. F. Andrews (482) of New York State contains information regarding the status of silicosis-compensation cost in the United States:

> For the 14 years 1920-33 the experience of Wisconsin, a full-coverage State, shows benefits of $1,423,569 for occupational disease out of a total of $59,595,901 for all industrial cases. Occupational diseases cost slightly less than 2.4 percent of the whole. * * *.
>
> The cost statistics for this protection in Wisconsin, moreover, give an exaggerated picture of the real load in normal times. Wisconsin, like most States, has its silicosis problem. It is a disease produced by long years of exposure to fine silica dust. The average length of exposure in Wisconsin cases is shown to be 15 years. The disability comes on gradually and usually takes the employee off duty, first for a day and then for a week, a month, and so on to complete incapacity and death. The depression forced many of these workers off duty. Their physical condition had progressed to the point where they could not engage their services elsewhere. Their physicians found their condition to be silicosis, and they filed their claims for compensation. Many of them, but for the depression, might have continued on duty more or less irregularly, though not to their advantage or any escape from the end result. The unemployment situation, however, did mass the claims into this period and into the statistical experiences for this period, where otherwise they might have been spread over the years yet ahead.
>
> The experience for these depression years shows an average annual cost for the "dust classification" to be five times as great as in previous years. The whole occupational-disease schedule also showed, in comparison with cost of all compensation, a material increase in this period, but aside from the effect produced by the silicosis experience this is not a very real change. The total compensation case and cost load is so tremendously reduced, because of unemployment and reduced wages, that any comparison of such figures with those actively influenced by the silicosis figure, which built up and not down because of the depression, gives a false notion.
>
> The silicosis experience has affected just a few industrial classifications; for example, iron and steel foundries, marble and granite works, and those other industries that make use of sandblasting in their manufacturing process. The large number of employees in these industries shown by physical examinations to have been damaged by their employment has prompted most extraordinary concern for the elimination of the dust hazard. It is again demonstrated by this very experience with silicosis that knowledge of the problem, coupled with the obligation to compensate, gets the character of attention at the source of danger which will reduce the load to a minimum. Those States that meet the obligation squarely will soon see how employers protect their employees and protect themselves.
>
> In New York State, insurance interests, in estimating the number of employees exposed to silica and other dust diseases at 20,000 have adopted an outside figure. Using the federal census of 1930, the division of

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industrial hygiene of the State department of labor has estimated that about 3,000 workers, of whom 2,600 are stonecutters, are under "serious exposure" to silica dust, that is, to dust containing 40 millions or more particles of dust per cubic foot.

About 2,200 workers are subject to "moderate exposure" of from 30 to 40 millions of particles per cubic foot. Of these, more than 1,600 are engaged in glass-factory operations, 284 in foundry work, 111 in stonecutting, 163 in pottery making, 42 in buffing and polishing, and 40 in grinding.

Of the approximately 3,000 suffering "slight exposure", that is, of from 20 to 30 millions of particles per cubic foot, about 850 are buffers and polishers, 592 are engaged in stonecutting, 650 in glass manufacture, 473 in foundry work, about 200 in grinding and about 85 in pottery making.

Of the approximately 31,000 suffering "negligible exposure", that is, less than 20 million particles of dust per cubic foot, 8,700 are engaged in foundry work, 3,600 in quarries, 3,300 in buffing and polishing and the others are distributed through 10 classifications.

When, prior to Governor Lehman's veto of the silicosis bill, some insurance companies were canceling policies and proposing to triple rates on certain plants, in addition to requiring cash deposits of $400 per employee on the theory that one-fourth of the persons "exposed" might be found to have silicosis or other dust diseases, an examination of all foundry employees in a large plant in the State showed that 95 percent had no symptoms of such diseases. Four percent were found to have symptoms of first-stage silicosis, and only 1 percent had second-stage symptoms.

The immediate effect of bringing silicosis and other dust diseases under the provisions of the occupational-disease amendment will be to stimulate prevention. It is now of direct cash benefit to employers to see to it that silica and other harmful dusts are not released in their plants. Adequate exhaust systems, suction devices, and the substitution of other substances for those containing silica now in use will tend to lower the insurance rate and to lessen the number and severity of claims.

In Massachusetts (483) the compensation-insurance rate for stonecutting per $100 of pay roll was raised from $2.84 to $4.50 in December 1927. In 1934 the rate was $5 plus an additional occupational-disease-hazard payment of $300 per year for each employee where conditions warrant.

The State compensation department has advised the West Virginia Coal Association that under the silicosis-compensation legislation, which became effective March 1935, rates charged subscribers for coverage in the workmen's compensation silicosis fund will be measured by the degree of exposure to the dust hazard with an allowance for dustproof equipment, including respirators. With a reduction of 60 percent for dustproof equipment, including respirators, it is not expected that the rates will be unduly burdensome or excessive, except where the degree of hazard is unusually high. Although dependent on the dust hazard, the rate may drop as low as 5 or 10 cents on $100 of pay roll.

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It would be difficult to ascertain the maximum under the worst conditions where all employees are exposed and the dust particles per cubic foot are counted in millions.

According to the West Virginia Coal Association (484) the compensation law was urged by some of the industries in which employees were exposed to dust in harmful quantities - largely the glass and sand industries. To July 27, however, only three industrial companies had elected to join the silicosis fund. No coal company had elected to subscribe to the silicosis fund. Apparently the silicosis statute does not divest an employer of his common-law defenses if he does not elect to join the fund, although the language of the act is considered "nebulous."

The most complete figures available on cost of compensation for silicosis probably are those for South Africa where silicotic miners are compensated according to the three stages of the disease defined by law (485). For the first two stages - anteprimary and primary - lump-sum compensation is paid. When the disease progresses to the secondary stage, where capacity for work has been seriously and permanently impaired, the miner is given a monthly life pension for himself and allowances for his wife and children under 16 years of age. According to the South African Mining and Engineering Journal (486) pensions were being paid at the end of March 1934 to 1,659 miners with additional allowances for 1,283 wives and 2,393 children; monthly allowances also were being paid to 5,615 dependents of dead miners. At this time a total of £963,240 had been paid in benefits to native laborers under the Miners' Phthisis Act. Lump-sum awards were made during the year to 422 men, the average award to those in the anteprimary stage being £379, in the primary stage £522, and in tuberculosis cases £521. The maximum awards in the three classes were £788, £550, and £935, respectively. Awards payable in monthly installments were made to 50 miners and pensions to 261 miners and 199 dependents. By March 31, 1934, 3,099 miners who had been granted monthly allowances for secondary silicosis or tuberculosis with silicosis had died, the average period of life from the date of the bureau's certificate being 3.95 years. Allowances also had been granted or continued to 351 children of miners who had attained the age of 16 but were unable to earn a living.

The cost to the mines of compensation allowances is heavy (485). From April 1, 1931, to March 31, 1932, total compensation expenditures for European miners were £716,107, for natives £58,031, and for the Miners' Phthisis Board, Miners' Phthisis Medical Bureau, and the Medical Board of Appeals £50,855. During this period 32,627,720 tons of ore were milled and 10,484,403 ounces of gold recovered. Silicosis compensation therefore cost about 6d. per ton of ore milled and about 1s,7d. per ounce of gold recovered. With an average of about 11,000 European workers employed underground the cost was about 4s. per European underground shift. The total amount paid to 1934 under the miners' phthisis laws exceeds £14,000,000; during the same period total contributions of the mining companies exceeded £17,000,000 (486). The annual levy on the scheduled mines (33 were on the list on March 31, 1934) for 1934 awards was £800,000 in addition to an outstanding liability, capitalized at a present value of £11,500,000, for which the individual companies must make annual provision and for which the scheduled mines collectively are responsible.

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Most of the past and current cases of miners' phthisis in South Africa have been among underground employees who were in the service of the gold mines before 1916 (485). Since then, especially in recent years, conditions have improved greatly. According to the Government Mining Engineer (485) "technical and medical measures which have been directed for many years, and with continued improvement in detail, to the all-important problem of the prevention of silicosis have attained a very substantial measure of success." The fact that no new miner who entered the industry since 1923 has yet contracted silicosis (485) is encouraging.

In Great Britain the total number of cases of silicosis and asbestosis in which compensation was paid under the compensation schemes in 1933 was 1,399 and the total amount paid was £109,286. There were 28 fatal cases in the coal-mining industry for which compensation costs amounted to £7,142; 103 disablement cases continued from previous years; and 126 new disablement cases were paid £16,451 (487).

In Ontario, Canada, the total cost of silicosis compensation in 1932 was $301,067.75 (442). Gold mines of the province that year milled 5,497,177 tons of ore which yielded 2,264,051 ounces of gold. If silicosis compensation is assumed to be chargeable solely against the gold-mining industry the cost per ton of ore milled was about 5½ cents, and the cost per ounce of gold recovered was about 13 cents. In 1934 a representative of the Ontario Department of Mines (488) said that the silicosis hazard costs 1¼ percent of the total mine pay roll, although only 2½ percent of the men employed by the mining companies are actually exposed. He estimated that each case cost the companies $11,000 to $12,000. According to the Toronto Evening Telegram (489) silicosis costs $1 for every $5 expense in mining and concentrating a ton of gold ore.

At Broken Hill, Australia (442), a total of £1,141,938 had been expended as of June 30, 1933, for compensation of mine workers suffering from pneumoconiosis or tuberculosis in the 12½ years since the passage of the Workmen's Compensation (Broken Hill) Act of 1920. During this period the Broken Hill mines hoisted about 13,000,000 tons of ore. Compensation cost per ton of ore hoisted was therefore about 1s. 9d. Compensation at Broken Hill now amounts to about £1,000,000. During the fiscal year 1932-33 payments from the Broken Hill pneumoconiosis tuberculosis compensation fund totaled £120,000 ($577,000).

Data published in the Sixth Annual Report of the Workmen's Compensation Commission of New South Wales (490) indicate that the cost and expense of compensation for silicosis in special occupations in the County of Cumberland, Australia, from September 1927 to April 1932 averaged about 6 percent of the pay roll.

In Germany from 1930 to 1933 more than 1,400 miners are said (491) to have died of rock-dust lung disease (silicosis) in the principal mining district Dortmund; during this period 4.4 million marks were spent on the "survivors of the silicosis sacrifice", and to January 1934 additional pensions were paid to about 1,500 widows and 1,100 orphans. In all, 17.4 million marks were expended for silicosis cases during the period 1930-33. At the end of 1933 about 217,000 men were employed in the Ruhr district - 11,500 in occupations involving

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work in rock. About 17 percent of the assessments raised by section 2 of the Miner-Employer Cooperative Liability Insurance Co., at Bochum, that is, for a mine producing 4,000 to 5,000 tons of coal per work day - 60,000 to 70,000 marks annually is devoted to compensation of silicosis; Bax (491) assumes that the burden, already great, from this occupational disease in the mines will continue to increase.

Although the data given above on the cost of compensation for silicosis are not extensive or complete they at least indicate the cost to the mining industry where such compensation has been part of the cost of operation for some time.

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SUMMARY

In a recent paper on silicosis Barber (492) stated:

> After reading a good many pages by a considerable number of authors, I feel that we are at present in a rather vague state regarding silicosis. A few years ago it had all been worked out in a one - two - three manner - quite understandable - but recently the authorities have taken to disagreeing over many phases of the subject and seem to be actively engaged in further studies and researches with the view of rewriting the whole subject. Perhaps we will better understand the new, however, if we are more familiar with the work up to this date.

The review of the literature on dust diseases in general and on silicosis in particular, presented in Bureau of Mines Information Circulars 6835, 6840, 6848, 6857, and 6892, has been prepared to assist those to whom much of the information is not available in becoming "more familiar with the work up to this date." It was not practicable to include all the material on the subject, the extent of which is indicated by the fact that a bibliography on "the pneumonokonioses (silicosis)" lists 2,768 separate articles, including references to the literature through 1933.

A summary of some of the points mentioned or discussed in these Bureau of Mines circulars follows:

1. Dust has been defined as solid particles (usually dry, but they may be wet) ranging in size from less than 1 micron (1/1,000 millimeter or approximately 1/25,000 inch) to about 150 microns.

2. Physiologically, there are almost as many different classifications of dust as there are authors on the subject; these classifications probably are not particularly important since in daily practice in industry the harmful effect is produced more frequently (one might say, almost invariably) by dusts of mixed origin. An attempt to group dusts under the headings "active" and "inert" (with reference to effect on health) has proved unsatisfactory since the further the subject is investigated the more it becomes apparent that practically all dusts may be harmful if breathed in large amounts over long periods.

3. The extent of the dust hazard in industry in the United States is not known definitely, and exact data on the number of persons exposed are not available though some rough estimates have been made.

4. So far as known at present, silica dust apparently is the most harmful to breathe of the dusts ordinarily encountered. Silicosis (so-called), the disease caused by breathing silica dust, is a widespread industrial hazard which probably is increasing and affects appreciably the death rate among industrial workers exposed. The Silicosis (Medical-Arrangements) Committee of Great Britain reported in 1929 that "silicosis is more widespread

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than is generally believed and occurs to some extent in a number of industries and occupations where its presence has not been suspected." Essentially, this opinion has been expressed by some authorities in the United States, particularly lawyers who have handled any considerable number of dust cases legally.

5. Various writers on industrial diseases have referred to harmful effects of exposure to dust for centuries, at least as far back as 75 A.D. when Pliny refers to it.

6. Dust diseases are found among workers in dusty trades all over the world but are more prevalent, or at least have received maximum attention, in such industrial countries as Great Britain, Germany, Australia, South Africa, Canada, and the United States.

7. In the United States dust disease, usually designated "silicosis", is more or less common among workers in the mining, grinding, granite, and foundry industries; it also is found to some extent in more than 100 other occupations or industries.

8. As regards types of dust injurious to health, it appears that any dust insoluble or difficultly soluble in the fluids of the respiratory passages and in sufficiently finely divided form to float in the air and be breathed by workers in considerable quantities over long periods ultimately will be harmful. Although free silica dust (SiO_2) has been considered the most harmful, silicates (for example, asbestos) have been found almost as harmful, and other dusts certainly have a detrimental effect upon health under certain conditions.

9. The following terms are commonly used to describe dust diseases of the lungs: (1) "Pneumoconiosis" (from Greek pneumon, lung, and konis, dust), a general term for all dust diseases of the lungs; (2) "silicosis", a condition of the lungs due to inhalation of silicon dioxide or free silica; (3) "silicatosis", a disease of the lungs thought to be caused by silicates; (4) "anthracosis", a dust disease of the lungs of coal miners; (5) "siderosis", a diseased condition of the lungs of metal workers, particularly in iron or ores of iron; and (6) "asbestosis", a lung disease caused by breathing asbestos dust. The generic term "pneumoconiosis" or possibly the simpler one "dust disease" appears to represent more accurately the common types of dust disease because numerous dusts usually are involved.

10. Silicosis is characterized by fibrotic changes in the lungs which are said to be more clearly noticeable and easier to diagnose than changes due to other dust diseases of the lungs. The dust of free silica is considered more dangerous than other dusts chiefly because its victims are thought to be more liable to contract tuberculosis than persons exposed to nonsiliceous dusts.

11. The symptoms of silicosis are shortness of breath (dyspnoea), pains in the chest, cough, expectoration (coughing and spitting material), hemoptysis (spitting blood), night sweats, loss of strength, and gastrointestinal symptoms; most of these symptoms also accompany diseases caused by at least some other dusts.

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12. According to Pancoast the pathological features of silicosis are: (1) Entrance of dust; (2) "dust cell"; (3) entrance of dust cell into the lymphatic system of the lungs as a carrier of silica particles; (4) influence of deposited silica in the production of fibrous tissue; (5) action of silica; (6) elimination of dust; (7) predisposition of the fibrotic and silica-saturated lung to respiratory infections, especially tuberculosis.

13. The mechanisms provided to protect the lungs from the accumulation of foreign particles are the mouth and nose, through which the respiratory tract opens to the surface of the body, the latter being guarded by a coarse filter of hair; behind this a series of tortuous passages with moist walls which trap many smaller particles; and cells covered by the cilia (minute vibratory hairs) line the nasal cavities, portions of the upper respiratory tract, the pharynx, the trachea, and bronchi, the wavelike vibrations of which tend to carry particles lodging on their surface away from the lungs and back toward the surface. These with other protective mechanisms, are adequate to protect against ordinary amounts of atmospheric pollution, but if work is continued in a very dusty atmosphere for long periods these protective devices cannot cope with the situation, the mechanisms themselves are damaged, and the dust particles collect where the air should be, or possibly prevent air from going where it is expected to go and is needed.

14. In some countries silicosis has been divided arbitrarily into three stages for convenience of description and possible compensation purposes: In the first stage (as designated in the United States) the symptoms are few and often indefinite, and the working capacity is not noticeably impaired; in the second stage a definite shortness of breath on exertion is usually experienced, work cannot be performed as well as formerly, and the chest expansion is noticeably decreased; in the third stage the shortness of breath is marked and distressing on slight exertion, the cough is more frequent, the capacity for work is seriously and permanently impaired, chest expansion is greatly decreased, flesh is likely to be lost, pulse rate may be increased, the heart may become dilated, and usually tuberculosis has intervened. Differentiation between the various stages is likely to be anything but definite.

15. The radiographic or X-ray appearance in the first stage is generalized arborization with small, discrete mottling due to shadows cast by the individual nodules of fibrous tissue in the lungs; in the second stage the characteristic radiographic appearance is a generalized medium-size mottling throughout both lung fields, with here and there larger but limited opacities due to irregular pleural thickening or to a localized aggregation of nodules; in the third stage the radiographic appearances are further accentuated, the mottling is more intense, the nodules are larger and assume a conglomerate form so that large shadows are shown corresponding to areas of dense fibrosis, and tuberculosis usually has developed.

16. Diagnosis of silicosis is made by clinical, pathological, and radiological examination; family, personal, and occupational histories, together with physical examination, are usually held to be necessary. It is generally accepted that at least up to the present the X-ray offers the best indication

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of the lung changes that occur in silicosis, particularly in the early stage; however, the X-ray in itself appears to be anything but reliable in the definite determination of the disease. Classification of the fibrotic changes revealed by the X-ray are given in detail.

17. The exact process by which fibrous tissue is formed in the lungs as a result of the presence of dust is not known. At one time it was believed that fibrosis was produced in response to the irritation caused by the hard, sharp quartz particles as well as through filling or partial filling of lungs with dust - that is, the dust was supposed to act mechanically; at present many, probably most, investigators consider solubility a primary factor in the harmfulness of silica and claim that a substance insoluble in the respiratory fluids and tissues cannot cause dust disease of the lungs. In other words, many believe that the action is chemical rather than mechanical; a rational view seems to be that the harmful action is of both chemical and mechanical origin.

18. No cure is known at present for silicosis; prevention therefore appears to be the only effective remedy, at least until science comes to the front with some "cure" not now available.

19. Prevention of dust disease in industry involves the engineering problem of controlling dust production and "conditioning" the air breathed by workers by removal of dusts, gases, temperature, and humidities likely to be harmful to those who breathe that air and the medical problem of selecting workers by preemployment physical examinations and periodic examinations to determine the effectiveness of the dust-control measures.

20. Maintenance of a condition of minimum dustiness of air breathed by workers is fundamental in controlling dust diseases; primarily this requires constant, controlled, adequate ventilation with or without other air-conditioning measures.

21. The principal dust factors that produce pulmonary pathology are now thought to be: Nature of dust, particle size, quantity of dust in the atmosphere, and length of exposure to dusty air. There are probably numerous other factors, however, that exert a more or less definite influence, such as gases, temperature, humidity, posture, rate of work, and nativity.

22. Free silica or quartz has been considered the outstanding dust factor in industries with excessive mortality from dust diseases, although recent discussion indicates that sericite is the offender. Silica is one of the most common minerals and is said to constitute approximately 60 percent of the earth's crust; a large part of this is free silica (quartz, chert, flint, etc.). Sericite is an insoluble fibrous silicate of aluminum and potassium, the minute particles of which are long and needlelike in shape.

23. The most dangerous dust is said to be that ranging in size from 5 to 0.5 micron or smaller; in other words, it is thought that the smaller the particles the greater the danger, and particles of these sizes are too small

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to be seen by the naked eye. The supposedly dangerous size, 1 to 5 microns, is roughly that of the tubercle bacillus. Large quantities of larger sizes which float in the air cannot be considered harmless, as they tend to clog the protective mechanisms of the respiratory tract and thus cause some harm in addition to allowing maximum quantities of smaller-size dusts to penetrate the lungs where they are likely to do the most damage. Also there is no definite knowledge that dusts much smaller than 0.5 micron are harmless; in fact, it is strongly suspected that these very small sizes may be very definitely harmful.

24. In South Africa, where the dust is said to contain more than 85 percent free silica as quartz, a tentative standard of 300 particles per cubic centimeter of air (about 8.5 million particles per cubic foot) has been set as the upper limit of dustiness allowable. In Wisconsin the industrial commission, employers, scientists, and others interested have agreed on a tentative figure of 15 million countable dust particles under 10 microns in longest dimension with free silica content of 35 percent in a cubic foot of air, as determined by United States Public Health Service technic. The permissible dust count of virtually pure silica is 5,250,000 countable particles; countable particles are those particles ranging from 2 to 10 microns in the longest dimension.

25. The length of exposure to silica dust required to produce silicosis depends primarily on the individual and the amount and size of the dust particles in the air breathed; however, numerous other factors may have a definite influence. In the granite industry some workers exposed to the heaviest dust develop silicosis after 2 years, while others do not develop the disease before 50 years of exposure. Among sandblasters silicosis may develop after 3 years of exposure; in Ontario gold mines it is said to develop in 9 or 10 years; in a sand-pulverizing plant the longest period of occupation before lung affection became apparent is said to have been 2.5 years at intervals and the shortest, 35 days during a period of a little over a year. Data collected by the United States Bureau of Mines in one study show that first stage silicotics had worked underground an average of 12.99 years for all men irrespective of occupation; those in the second stage had worked an average of 15.8 years for all men irrespective of occupation; and third-stage silicotics had worked an average of 18 years for all occupations. In this particular study the shortest period worked underground was 2 years for first-stage silicotics, and the longest was 40 years for third-stage silicotics. It appears probable that under some conditions death from dust disease and accompanying complications may occur in 2 years or even less from date of first exposure to heavy concentrations under unfavorable conditions of temperature, humidity, noxious gases, exposure, etc.

26. Determination of dust in air breathed by workers is necessary before measures can be taken to prevent dust disease; moreover it is economically important as evidence of the extent of the dust hazard involved in dusty processes and as a measure of the efficiency of protective devices introduced to mitigate the hazard. The various methods that have been and are being used are described. The final choice of an instrument for sampling dust depends on its efficiency, its relative freedom from errors in analysis, its ruggedness, portability and weight, and on the difficulty or ease with which the samples obtained may be analyzed. The instrument or method should eliminate as far as possible variation

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or errors due to the "human equation" - a difficult requirement and one apparently not yet reached. A suitable instrument or method for determining air dustiness in one industry may not necessarily be applicable to conditions in another industry, though as far as feasible instruments and methods should be kept standard for all industries to permit correlation of results.

27. Information is given on engineering methods of controlling dust in the mining, abrasive, grinding, foundry, and granite industries.

28. Textbooks on ventilation and engineering handbooks devote little or no space to methods of controlling industrial dust; less than 1 percent of the articles in an extensive bibliography on dust diseases deals with engineering control.

29. No definite, absolutely reliable standards of allowable dustiness are known; therefore the aim in the prevention of dust disease should be to eliminate dust from the atmosphere breathed by workers or at least to reduce the dust content to the lowest figure feasible. Considering the many uncertainties of the present day, standards, especially in legal requirements, should be tentative and flexible rather than permanent and rigid.

30. The remedy for the apparently concerted effort to hide the facts regarding dust diseases in industry is education of workers in the necessity of taking available precautions, including physical examinations; of employers in recognizing the seriousness of the situation and in providing devices and methods to reduce or prevent the incidence of disease and, if necessary, force their adoption on the workers; of doctors in correctly diagnosing disease, giving publicity to its prevalence, seriousness, preventive remedies, etc., and assigning in death certificates dust disease as the cause if such is the case; and of merchants, newspapers, and other influences in the community in trying to prevent the disease rather than to hide its existence.

31. Employers should not conclude that they have eliminated entirely the danger of silicosis or of any type of pneumoconiosis simply because the air is seemingly free from dust; as far as now known, the particles likely to do the most harm are invisible and remain long in suspension in the air unless it is replenished by fresh, pure air at frequent intervals through ventilation.

32. The methods of reducing dust in South African mines that are said to have been effective in preventing the incidence of dust diseases for the past several years are: Wet drilling, water spraying (by water blast), filtration, requiring adequate time between blasting and return to the working face, air sampling, ventilation, and wearing of masks.

33. The main sources of dust in metal-mine air in the order of importance are: Dry drilling holes for blasting; blasting; shoveling or "mucking" very fine dry material at the working face, which is usually poorly ventilated; loading cars from chutes; dumping loaded cars into chutes; and timbering. Dry crushing and other occupations in metal-mine mills are also likely to be dangerously dusty.

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34. The most dangerously dusty occupation in coal mines is cutting dry coal by mining machines; blasting, shoveling, drilling, and rock dusting by machinery are also very dusty operations. In addition to the miners and their helpers, rockworkers and timbermen and drivers who have to enter the miners' workplaces when the air is particularly dusty are exposed to relatively large amounts of dust.

35. The best remedy for the dust menace in mines, other than preventing its formation, appears to be the universal coursing of currents of air to remove the dust, as it has been proved that the very fine, most dangerous dust in metal mines remains suspended in still air for several hours. Dust-prevention devices of proved success, such as the present-day self-rotating wet stoper and other wet-drilling equipment, should entirely supplant dry drilling; their use should be enforced upon both miners and operators in metal mines. Care should be taken, however, that holes are not started or "collared" dry. To date no workable device is available for removing dust in dry drilling in underground mines.

36. Various "dust traps" to prevent the dissemination into the atmosphere of dust produced by drilling in rock with pneumatic percussion drills are described; these devices are used in mines of the United States to only a very limited extent.

37. The advantages and disadvantages of dust respirators are discussed. On August 20, 1934, the United States Bureau of Mines issued an approval schedule for dust respirators describing the procedure for testing filter-type dust, fume, and mist respirators for permissibility; several respirators have already been approved under this schedule.

38. Dust filters developed in South Africa for removing dust produced in ore bins and at tippler stations are said to have dust-catching efficiencies of 98 percent or more.

39. In industries other than mining the processes used vary so widely and call for such different treatment that each must be studied separately. Methods recommended for eliminating dust are: Local exhaust ventilation to remove the dust at point of origin; substitution of nonsilicosis-producing material as a metal abrasive for sand, nonsiliceous parting compounds for molds in foundries, and clay instead of flint in bedding potteryware for baking; enclosure and segregation of dusty processes, as the use of sandblasting cabinets; suppression of dust by water spray and steam; general mechanical ventilation; plant cleanliness, which is as important as upkeep of protective equipment; protection of workers by masks and helmets, although such devices should be considered only emergency equipment as dustiness should by all means be controlled by such measures as dust-collecting equipment and exhaust fans if feasible; medical supervision with periodical physical examinations of workers; education of workers; and dust counting to check the efficiency of the measures.

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40. If much progress is to be expected engineers, operating officials, and doctors must cooperate in the control of dust diseases. The most important measure in the medical control of dust diseases is physical examination of workers before employment and at stated intervals thereafter. It has been found that certain defects and diseases are predisposing causes of silicosis. According to German investigators workers with poor nasal filtration are more susceptible to dust diseases. A man with a good sound physique and with good reserve respiratory capacity is said to be best suited for underground work in mines. Age is also important; a man with a good chest and good reserve can carry without inconvenience or loss of health enough fibrosis to seriously affect one with poor reserve or a chest becoming rigid with age. All persons with signs of tuberculosis taint or tendency should be rigorously excluded from dusty occupations irrespective of silica content of the dust.

41. A plan for medical control includes establishment of a medical department adequately equipped; routine examination of applicants for employment; rating and placement of applicants; periodical physical examinations; and provision for the disabled. Methods of conducting examinations are outlined.

42. No cure is yet known for silicosis. At one time it was thought that removal of the victim from further contact with dust would arrest the condition at the point of development reached when discovered; although this practice is effective in some instances, generally it is not now considered the solution, and in some mining localities the removal system is not utilized.

43. Earlier investigators believed that so-called "protective" dusts would cause the excretion from the lungs of such harmful dusts as silica by exciting the physiological process of elimination and that these "protective" dusts acted in some way to prevent the development of tuberculosis; some still hold this opinion. Coal dust, iron-ore dust, clay dust, and dusts of calcium minerals have been suggested and tried in the treatment of silicosis; there has been great divergence of opinion of various investigators regarding the harmfulness or harmlessness of these dusts and their efficacy in preventing silicosis and tuberculosis, when mixed with dusts definitely agreed upon as harmful, or their harmfulness when breathed alone. However, the belief is growing that any dust or combination of dusts if breathed in large enough quantity over a long enough period will cause diseases of the respiratory organs.

44. Recently dust diseases - especially silicosis - have jumped from obscure, scarcely recognized diseases to front-page headlines in the daily press because of the sudden realization that a very important economic hazard is menacing industry. This publicity is the result of the filing of suits for damages from dust diseases totaling millions of dollars. Damages as high as $25,000 have been awarded by the courts in individual cases. Although denounced as "racketeering" it has been found in many instances that the cases are authentic even as applied to dusts supposed to be relatively harmless. These suits have aroused industry to the gravity and magnitude of the situation, and publications representing some of the dusty industries are demanding that some national organization such as the Bureau of Mines be given funds to make a thorough investigation and to coordinate activities of industrial hygienists, public-health authorities, labor and law-making bodies, and the industries themselves.

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45. All do not agree that inclusion of dust diseases in compensation schemes for occupational diseases is a solution of the problem. Some writers on the subject, however, have suggested that unscrupulous lawyers and doctors are more likely to be deterred by compensation laws from preying upon both labor and capital than if occupational disease is left wholly to adjudication in the courts or otherwise.

46. As an outcome of these suits, it appears that organizations that can prove they have made "reasonable" effort to safeguard the health of their employees may not be held liable for damages. Some familiar with the legal phases of the problem have emphasized that the only solution of the silicosis or dust-health situation lies in prevention, as the cost of compensating for it is too great for industry, however it is paid.

47. It is recognized that in extending compensation coverage to occupational diseases the subject is much more complex than that of accidents; the recent emphasis placed upon silicosis appears somewhat analogous to what would occur should accident prevention and compensation be predicated only on the occurrence of the worst form of accident, namely, permanent total disabilities such as broken backs.

48. The status of compensation for silicosis in the United States, Canada, Great Britain, South Africa, and Australia is summarized, and the important features of the laws and methods of enforcing them are more or less briefly described.

49. The main effectiveness of the preventive aspects of silicosis schemes is said to lie in their power to set up a standard of physique for new entrants into the industries, based on periodical medical examinations; this procedure would have ramifications affecting safety, production, and probably other phases of industrial work also.

50. The pressure of occupational disease (especially dust disease) on insurance companies has increased so much as to threaten financial ruin in some instances; consequently, insurance companies are decidedly active in connection with investigations, research, and all other phases of occupational disease, especially dust disease. Compensation premium rates are being materially increased in some States to try to cover the risk due to dust and other occupational diseases; some of these increased rates are almost prohibitive.

51. Much of the information regarding the cost of legal compensation for silicosis has been obtained from foreign countries, especially the members of the British Empire, as most of the silicosis-compensation laws in the United States are too recent to determine the cost of their operation, and assembled data on law suits settled or otherwise handled are difficult to obtain.

52. The most complete figures available are probably those for South Africa. The total amount paid for silicosis compensation since the enactment of the miners' phthisis laws of South Africa to 1934 exceeds £14,000,000 (about $70,000,000). The cost per ton of ore milled has been about 6d.

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(about 12 cents) and per ounce of gold recovered 1s.7d. (about 38 cents); the cost per underground European shift was about 4s. ($1.). In Canada it is said that cost of silicosis compensation is 1 1/4 percent of the total mine pay roll, although only 2 1/2 percent of the men employed by the mining companies are actually exposed. It has been estimated that each case costs the companies $11,000 to $12,000. It has also been said that for every $5 spent in mining and concentrating a ton of gold ore $1 is required for silicosis.

CONCLUSIONS

The literature on the effect of breathing dusts is full of various kinds of data, experimental, theoretical, and factual; it comes from nearly all civilized countries; it covers nearly all phases of the subject but lacks much of conclusiveness in almost any or every phase except possibly that harm to health can be expected from prolonged breathing of excessive amounts of dust; there appears to be good reason to believe that this applies to practically any or all dust or combination of dusts, organic or inorganic.

Almost innumerable uncertainties are connected with the harmfulness of dust, but dust is now generally believed to be detrimental to health through its effect of one kind or another on throat, bronchial passages, lungs, stomach, and other internal organs, as well as eyes, ears, nose, other external organs, and the skin covering the entire body. Many dusts (metal, mineral, and organic) are explosive; others fire spontaneously with more or less readiness under varying conditions; and practically all dusts have almost universally detrimental effects upon settlement, whether in the home, in the office, or on the external surfaces of buildings or on the roads, streets, or sidewalks. All of these facts (and others can be added) make dust one of the real scourges of present-day life, and certainly no sane person can deny that a most determined effort should be made to reduce dust or at least to confine it in such manner as to minimize its numerous harmful effects.

It now seems probable that the most harmful of the ordinary dusts to breathe is that of silica, but on the other hand not even free silica (supposedly the most detrimental of the silica dusts) is harmful unless it is breathed in considerable quantities and over considerable periods of time; no human being ever lived any considerable period of time on this earth of ours without breathing silica dust (free silica dust), yet by no means all of the people of the world have or have had silicosis. In other words, the quantity of dust taken into the respiratory organs is a controlling factor in dust respiratory harmfulness, and common sense indicates that quantity of dust breathed is one of the dominant factors as to possible harmfulness from any kind of air-borne dust. What constitutes that quantity limit no human being knows at this time, notwithstanding the fact that numerous so-called threshold limits are now being announced, some of them being embodied in State regulations or laws. Predicating dust respiratory harmfulness on a sliding scale in proportion to the free-silica content of the dust is anything but logical; in the first place no one knows whether a dust of 1 percent silica is or is not more harmful than a dust of 2 percent or 3 percent or even of 30 percent. Moreover, air with a certain number of dust particles per cubic foot, with

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silica content 1 percent (or any other percentage) would probably be far more harmful to one person than to another, or would be far more harmful to a person working on a contract basis than to one on a day-pay basis, or more harmful to a person working in an atmosphere of 85° or 90°F., relative humidity 90 or 95 percent than to one working in an atmosphere of 60°F., relative humidity 60 percent. And there are numerous other more or less similar contributing factors which make unworkable or futile the establishment of regulations as to allowable number of dust particles on a sliding scale in proportion to silica content of the dust. In some industries, such as metal mining and tunneling, there may be as many different percentages of silica in the mine air as there are places working, and in many metal mines it is entirely unlikely that the percentage of silica in the air of a working place today will be at all like the percentage of silica in that same place tomorrow; to apply to most metal mines the sliding scale of allowable number of dust particles in the air in proportion to silica content would be utterly impossible of enforcement or fulfillment.

Much should be done to clarify numerous uncertainties as to air-dust harmfulness before trying to establish more or less rigid air-dust standards by legal means. At present there is as definite lack of knowledge as to the size of air-borne dust likely to be harmful, and present-day so-called standards of air dustiness are built on numerous uncertain premises on this point alone. Different authorities find varying maximum and minimum sizes of dust in lungs of deceased silicotics varying from as small as 0.2 of a micron to as large as 10 microns, and from this fact it is deduced that as far as lung harm is concerned the dust to be avoided is that from 0.2 to 0.5 micron on the low side to 6 or even as high as 10 microns on the high side; this leaves much leeway, because on air-dust sample containing 10,000,000 particles (0.5- to 6-micron size) per cubic foot of air might easily have 30,000,000 particles 0.2 micron to 10 microns in size. Moreover, if the solution theory of dust harmfulness to the lungs is correct, there is the best of reasons to think that particles much smaller than 0.2 micron are very likely to be harmful. And to hold that the only harmful dust sizes are those found in the lungs is anything but good reasoning because it is a certainty that dusts from 10 microns to 100 or more microns in size when floating in the air are drawn into the nostrils and other protective air passages and if in large numbers soon clog these protective agencies and passages giving practically free unobstructed entrance of the so-called harmful dusts (say 0.2- to 10-micron sizes) into the lungs to perform maximum injury. It does not seem to be logical to disregard these larger sizes entirely, as is now done almost universally in the so-called dust standards being considered and announced. Again the present-day instruments and methods of sampling air-borne dust and making the determinations as to number of particles present are anything but accurate or definite, even when handled by technically trained experts; and methods or instruments applied to certain industrial conditions are wholly unsuited to others. A condition as to air dustiness found in one sample in a certain place is unlikely to be anything like another sample taken immediately afterwards in the same place and in the same manner and this is true where the sampling is done instantaneously by grab method or over a period of several minutes. In other words the technic as to quantity particle determinations in air dustiness is by no means definite, accurate, fair, or dependable, not only as to conditions as between different

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plants but even as between different time periods in the same place in any one plant. With all of these (as well as numerous other) uncertainties as to air-borne dust, it seems to be a travesty on justice to try to embody in laws and regulations having force of law rigid standards as to air dustiness; if quantity standards as to air-borne dust are made they should certainly be labeled tentative, and the technic of taking the air samples and making the particle determinations should be very carefully outlined and enforced, otherwise much injustice can be inflicted through inexperience or the malice of the persons making the determinations.

This review of the voluminous literature on harm to health caused by breathing inorganic dusts has been confined to readily available data and almost wholly to respiratory disease and chiefly to lung affections. It gives little or no consideration to the numerous ill effects to human organs, other than the lungs, due to breathing more or less insoluble dust nor the harm to other internal organs (stomach, liver, kidneys, etc.), or to the nose, throat and bronchial tubes from breathing more or less soluble or so-called poisonous dusts; nor does it take into consideration the numerous hazards to human beings in breathing organic dusts, with the accompanying hay fever and kindred ills. Moreover, numerous dusts, both organic and inorganic, have harmful effects of various kinds on eyes, ears, and other parts of the body and on the skin from external contact; indeed, some dusts cause harm to health by absorption through the skin. Hence while pulmonary disease due to the breathing of air-borne dust is unquestionably of great present-day importance, its various ramifications (pneumoconiosis, silicosis, anthracosis, or these combined with tuberculosis) while vitally important constitute by no means the only detrimental effect to human beings in coming in contact with dust, externally or internally.

A close analysis of the status of dust in industry (and in general life outside of industry also) indicates that numerous, one might almost say unnumerable, uncertainties still exist as to specific features connected with dust harmfulness. So numerous and far-reaching are these uncertainties (only a few of which have been indicated in these conclusions) that almost the only definite fact now available is that dust is a menace, and that all kinds of it likely to come in contact with human beings should be reduced to a minimum or at least be held under positive control until much well-planned, well-correlated research and investigation (field and laboratory) have been conducted on almost every phase of the subject.

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